



University of Texas of the Permian Basin  
Odessa, Texas

**STC Lab 1212**  
**Finish-Out**

# PROJECT MANUAL

Odessa, Texas  
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79761

**06-15-20**

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**University of Texas of the Permian Basin**  
Odessa, Texas

## **STC Lab 1212 Finish-Out**

### **ODESSA, TEXAS**

**Prepared by:**  
**JSA Architects, Inc.**  
Odessa, Texas

**Agnew Associates, Inc.**  
Lubbock, Texas

06/15/20



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SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: University of Texas of the Permian Basin STC Lab 1212.
  - 1. Project Location: 4919 E. University Blvd., Odessa, Texas
- B. Owner: UTPB, 4901 E. University Blvd., Odessa Texas.
- C. Architect: JSA Architects, Inc., 4840 E. University, Suite 110, Odessa, Texas 79762.
- D. The Project consists of the finish out of existing shelled space on the first floor of the Science and Technology Building.

1.2 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price.

1.3 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

1.4 CONTRACTOR USE OF SITE AND PREMISES

- A. Arrange use of site and premises to allow:
  - 1. Owner occupancy.
  - 2. Work by Owner.
- B. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Use of tobacco products is not permitted within the building, on the site, or at any location on the Owner's property.

END OF SECTION

## SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

#### 1.2 SCHEDULE OF VALUES

- A. Form to be used: AIA G703.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify bonds and insurance and general conditions .
- F. Provide multiple line items for principal sub-contract amounts in excess of five percent of the Contract Sum.
- G. Allowances: Provide a separate line item for each Allowance.
- H. Revise schedule to list approved Change Orders, with each Application For Payment.

#### 1.3 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Initial Application for Payment: Prior to initial Application for Payment, provide the following:
  - 1. List of subcontractors
  - 2. Schedule of Values
  - 3. Preliminary Construction Schedule.
  - 4. Submittal Schedule.
- B. Payment Period: As determined by Owner.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- H. Submit three copies of each Application for Payment.
- I. Include the following with the application:
  - 1. Partial release of liens from major Subcontractors and vendors.
  - 2. Affidavits attesting to off-site stored products.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question.

#### 1.4 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor in the form of "Architect's

Supplemental Instructions" (ASI).

- B. For changes for which advance pricing is desired, Architect will issue a "Proposal Request" (PR) that includes a detailed description of the proposed changes that may require adjustment to the Contract Sum or Contract Time.
    - 1. Contractor shall prepare and submit a fixed price quotation within 20 days.
  - C. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation .
  - D. When changes to the Contract Sum or Contract Time are approved by the Owner, Architect will issue a document instructing the Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - E. Changes which are beyond the limits of established Allowances shall include no more than 10% of the cost of the changes for overhead and profit.
  - F. Substantiation of Costs: Provide full information required for evaluation.
    - 1. On request, provide the following data:
      - a. Quantities of products, labor, and equipment.
      - b. Taxes, insurance, and bonds.
      - c. Overhead and profit.
      - d. Justification for any change in Contract Time.
      - e. Credit for deletions from Contract, similarly documented.
    - 2. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
  - G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
  - H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
  - I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- 1.5 APPLICATION FOR FINAL PAYMENT
- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
  - B. Application for Final Payment will not be considered until the following have been accomplished:
    - 1. All closeout procedures specified in Section 01 70 00.

END OF SECTION

SECTION 01 21 00 - ALLOWANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Betterment Allowance.
- B. Payment and modification procedures relating to allowances.

1.2 RELATED REQUIREMENTS

- A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.3 BETTERMENT AND HARDWARE ALLOWANCES

- A. Costs included in the AllowanceS: Contractor's costs for products, delivery, installation, labor, supervision equipment rental and taxes.
- B. Costs not included in the Allowances: Contractor's costs for overhead, profit, bonds and insurance. These costs shall be included in the Contract Sum.
- C. Funds will be drawn from the Allowances only by Change Order.
- D. At closeout of Contract, funds remaining in Allowances will be credited to Owner by Change Order.

1.4 ALLOWANCES SCHEDULE

- A. Betterment Allowance: Include the stipulated sum/price of \$15,000.00 for use upon Owner's instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION



SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Submittal procedures.
- D. Project Management.

1.2 RELATED REQUIREMENTS

- A. Section 01 32 16 - Construction Progress Schedule: Form, content, and administration of schedules.
- B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Special Consultants.
  - 4. Contractor.
  - 5. Major Subcontractors or suppliers.
- C. Agenda:
  - 1. Execution of Owner-Contractor Agreement.
  - 2. Submission of executed bonds and insurance certificates.
  - 3. Submission of schedule of values, and progress schedule.
  - 4. Designation of personnel representing the Owner, Contractor and Architect.
  - 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 6. Scheduling.
  - 7. Use of premises by Owner and Contractor.
  - 8. Construction facilities and controls provided by Owner.
  - 9. Temporary utilities provided by Owner.
  - 10. Security and housekeeping procedures.
  - 11. Procedures for testing
  - 12. Procedures for maintaining record documents.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.2 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems that impede, or will impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Maintenance of progress schedule.
  - 7. Corrective measures to regain projected schedules.
  - 8. Planned progress during succeeding work period.
  - 9. Maintenance of quality and work standards.
  - 10. Effect of proposed changes on progress schedule and coordination.
  - 11. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### 3.3 PROJECT MANAGEMENT

- A. Contractor shall designate a Project Manager for the Project. Duties shall be as follows:
  - 1. Manage and control the project.
  - 2. Be assigned to the project during the entire construction.
  - 3. Attend all Project Meetings.

END OF SECTION

## SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Construction progress schedule, bar chart type.

#### 1.2 REFERENCES

- A. AGC (CPSM) - Construction Planning and Scheduling Manual 2004.

#### 1.3 SUBMITTALS

- A. Within 10 days after date of Agreement, submit an preliminary complete schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Submit updated schedule every 30 days.
- D. Submit original schedule - number of copies requested by Architect.
- E. Submit electronic file (PDF) when requested by Architect or Owner.

#### 1.4 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Include a separate activity for each portion of the work performed by Owner.
- C. Sheet Size: Multiples of 8-1/2 x 11 inches ( 216 x 280 mm ).

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.1 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate phases and other logically grouped activities.
- D. Provide sub-schedules to define critical portions of the entire schedule.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- F. Provide legend for symbols and abbreviations used.

#### 3.2 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

#### 3.3 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

END OF SECTION

## SECTION 01 40 00 - QUALITY REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. References and standards.
- B. Mock-ups.
- C. Control of installation.
- D. Tolerances.
- E. Mock-ups.

#### 1.2 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

#### 3.2 MOCK-UPS

- A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.4 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary sanitary facilities.
- B. Temporary Controls: Barriers and enclosures.
- C. Security requirements.
- D. Waste removal facilities and services.
- E. Temporary use of permanent equipment.

1.2 RELATED REQUIREMENTS

1.3 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Use of existing facilities is not permitted.
- C. New permanent facilities may not be used during construction operations.
- D. Maintain daily in clean and sanitary condition.

1.4 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.5 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:
- C. Entrances through temporary partitions: Provide entrances through temporary partitions as required for access.
  - 1. Provide walk-off mats at each entrance. Clean or replace mats on a regular basis as required to prevent tracking of materials into existing facility

1.6 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.7 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site weekly.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

1.8 TEMPORARY USE OF PERMANENT EQUIPMENT

- A. Use permanent HVAC equipment during construction only with approval of Owner.
- B. Provide MERV 8 rated filter at each return air grille in system being used.

- C. At end of construction, remove temporary filters and perform a complete cleaning of HVAC system ducts, units and coils.

1.9 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

## SECTION 01 60 00 - PRODUCT REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Transportation, handling, storage and protection.
- B. Product option requirements.
- C. Substitution limitations and procedures.
- D. Maintenance materials, including extra materials, spare parts, tools, and software.

#### 1.2 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

### PART 2 PRODUCTS

#### 2.1 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.

#### 2.2 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

#### 2.3 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver and place in location as directed; obtain receipt prior to final payment.

### PART 3 EXECUTION

#### 3.1 SUBSTITUTION PROCEDURES

- A. Substitutions during the bidding or proposal period:
  - 1. Architect will consider requests for substitutions submitted prior to 3 working days before date of bids or proposals.
  - 2. Requests for substitutions must be accompanied by completed substitution request form included in Project Manual.
- B. Substitutions after the bidding or proposal period:
  - 1. Substitutions after the bidding or proposal period will only be considered in the following cases:
    - a. The specified product is no longer manufactured.
    - b. The specified product is unsuitable for the intended use.



- c. The specified product is unavailable due to circumstances unforeseen by the Contractor.
    2. The Contractor's failure to obtain in a timely manner the specified product is not considered a justifiable reason for a substitution request.
  - C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
  - D. A request for substitution constitutes a representation that the submitter:
    1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
    2. Will provide the same warranty for the substitution as for the specified product.
    3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
    4. Waives claims for additional costs or time extension that may subsequently become apparent.
  - E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
  - F. Substitution Submittal Procedure:
    1. Submit electronic copies of request for substitution for consideration. Limit each request to one proposed substitution.
    2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
    3. The Architect will notify Contractor in writing of decision to accept or reject request.
- 3.2 TRANSPORTATION AND HANDLING
- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
  - B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
  - C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
  - D. Transport and handle products in accordance with manufacturer's instructions.
  - E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
  - F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
  - G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
  - H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.
- 3.3 STORAGE AND PROTECTION
- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
  - B. Store and protect products in accordance with manufacturers' instructions.
  - C. Store with seals and labels intact and legible.
  - D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
  - E. For exterior storage of fabricated products, place on sloped supports above ground.

- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SUBSTITUTION REQUEST FORM**

**TO: JSA ARCHITECTS**

**PROJECT:** \_\_\_\_\_

**SPECIFIED ITEM:** \_\_\_\_\_

Section	Page	Paragraph	Description
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The undersigned requests consideration of the following:

**PROPOSED SUBSTITUTION:** \_\_\_\_\_

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for it's proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by:

Firm \_\_\_\_\_

Contact \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Date \_\_\_\_\_

Telephone \_\_\_\_\_

Email \_\_\_\_\_

For use by Architect:

Accepted                       Accepted as noted

Not Accepted                   Received too late

By: \_\_\_\_\_

Date: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_

## SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Laying out the work.
- E. Hazardous Materials.
- F. Cleaning and protection.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

#### 1.2 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities.

#### 1.3 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

#### 1.4 COORDINATION

- A. See Section 01 10 00 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

### PART 2 PRODUCTS

#### 2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

#### 3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

#### 3.3 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

#### 3.4 LAYING OUT THE WORK

- A. Promptly notify Architect of any discrepancies discovered.

#### 3.5 HAZARDOUS MATERIALS

- A. Use products, cleaners and installation materials that are not considered hazardous.
- B. No asbestos containing materials shall be used in this Project.

#### 3.6 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### 3.7 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation only.
  - 1. Verify that construction and utility arrangements are as shown.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 .
- C. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Relocate items indicated on drawings.
  - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, and Electrical): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. Provide temporary connections as required to maintain existing systems in service.
  - 4. Verify that abandoned services serve only abandoned facilities.
  - 5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.

2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  - F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
    1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
    2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
    3. Where a change of plane of 1/4 inch ( 6 mm ) or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
  - G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
  - H. Refinish existing surfaces as indicated:
    1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
    2. If mechanical or electrical work is exposed accidentally during the work, recover and refinish to match.
  - I. Clean existing systems and equipment.
  - J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
  - K. Do not begin new construction in alterations areas before demolition is complete.
  - L. Comply with all other applicable requirements of this section.
- 3.8 CUTTING AND PATCHING
- A. Whenever possible, execute the work by methods that avoid cutting or patching.
  - B. See Alterations article above for additional requirements.
  - C. Perform whatever cutting and patching is necessary to:
    1. Complete the work.
    2. Fit products together to integrate with other work.
    3. Provide openings for penetration of mechanical, electrical, and other services.
    4. Match work that has been cut to adjacent work.
    5. Repair areas adjacent to cuts to required condition.
    6. Repair new work damaged by subsequent work.
    7. Remove samples of installed work for testing when requested.
    8. Remove and replace defective and non-conforming work.
  - D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
  - E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
  - F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- J. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  - 2. Match color, texture, and appearance.
  - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### 3.9 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### 3.10 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

### 3.11 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

### 3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.



### 3.13 FINAL CLEANING

- A. Execute final cleaning prior to Substantial Completion.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### 3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
  - 1. Provide copies to Architect and Owner.
- B. Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work.
- C. Submit Test / Adjust / Balance Reports.
- D. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- E. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
  - 1. Include written list of any work that is not Substantially Complete, reasons for incompleteness, and projected date of completion.
- F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- I. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

## SECTION 01 78 00 - CLOSEOUT SUBMITTALS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Project Closeout Documents.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

#### 1.3 SUBMITTALS

- A. Project Record Documents: Submit final documents to Architect with claim for final Application for Payment.
  - 1. Submit one preliminary full size set of record drawings. Architect will review and return comments to Contractor.
  - 2. Submit final documents as follows:
    - a. Two full size sets of record drawings.
    - b. Electronic file (PDF) of record drawings on USB drive or CD.
- B. Project Closeout Documents:
  - 1. Submit three sets of documents along with electronic files on USB drive or CD within 30 days of Substantial Completion, prior to final Application for Payment.
- C. Operation and Maintenance Data:
  - 1. Submit three sets of data along with electronic files on USB drive or CD within 30 days of Substantial Completion, prior to final Application for Payment.
- D. Warranties and Bonds:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 30 days after acceptance.
  - 2. Make other submittals within 30 days after Date of Substantial Completion, prior to final Application for Payment. Include submittals in Project Closeout Manual.
  - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 30 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

### PART 3 EXECUTION

#### 2.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Addenda.
  - 3. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.

- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
    - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
    - 3. Field changes of dimension and detail.
    - 4. Details not on original Contract drawings.
- 2.2 PROJECT CLOSEOUT DOCUMENTS
- A. Assemble closeout documents into durable manuals for Owner's personnel use.
  - B. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size.
  - C. Cover: Identify each binder with typed or printed title CLOSEOUT DOCUMENTS; identify title of Project.
  - D. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names, telephone numbers and email addresses of responsible parties.
  - E. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab.
  - F. Dividers: Provide tabbed dividers for each separate document; identify the contents on the divider tab.
  - G. Asbestos Free Certification: Provide a signed letter on Contractor's letterhead certifying that no products containing asbestos were knowingly used in the construction of the project.
  - H. Arrangement of Contents: Organize as follows:
    - 1. Table of Contents.
    - 2. Project Directory.
    - 3. Contractor's Warranty.
    - 4. Asbestos Free Certification.
    - 5. Contractor's Affidavit of Payment of Debts and Claims.
    - 6. Contractor's Affidavit of Release of Liens.
    - 7. Contractor's Consent of Surety (for bonded projects).
    - 8. Signed Substantial Completion Form.
- 2.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES
- A. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
  - B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- 2.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS
- A. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
  - B. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - C. Include manufacturer's printed operation and maintenance instructions.

D. Additional Requirements: As specified in individual product specification sections.

## 2.5 ASSEMBLY OF OPERATION AND MAINTENANCE DATA

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch ( 216 by 280 mm ) three D side ring binders with durable plastic covers; 2 inch ( 50 mm ) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- F. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- G. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- H. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- I. Arrangement of Contents: Organize each volume in parts as follows:
  - 1. Table of Contents, of all volumes, and of this volume.
  - 2. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Operation and maintenance data.
    - b. Photocopies of warranties and bonds.

## 2.6 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 30 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

## SECTION 06 10 00 - ROUGH CARPENTRY

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Concealed wood blocking, nailers, and supports.

#### 1.2 REFERENCE STANDARDS

- A. PS 20 - American Softwood Lumber Standard 2020.

#### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

### PART 2 PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://www.alsc.org)) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

#### 2.2 ACCESSORIES

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

#### 3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Provide the following specific non-structural framing and blocking:
  - 1. Cabinets and shelf supports.
  - 2. Wall brackets.

END OF SECTION

## SECTION 07 92 00 - JOINT SEALANTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
  - 1. Dow Chemical Company: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
  - 2. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  - 3. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
  - 4. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.2 JOINT SEALANT APPLICATIONS

- A. Scope:
  - 1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. Other joints indicated below.
  - 2. Do not seal the following types of joints.
    - a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - c. Joints where installation of sealant is specified in another section.
    - d. Joints between suspended panel ceilings/grid and walls.
- B. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

1. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings:  
Mildew-resistant silicone sealant; clear.
  - C. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- 2.3 NONSAG JOINT SEALANTS
- A. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
    1. Color: Clear.
  - B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
    1. Movement Capability: Plus and minus 25 percent, minimum.
- 2.4 ACCESSORIES
- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  - B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
  - C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
  - D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
  - E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

#### 3.2 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

## SECTION 09 51 00 - ACOUSTICAL CEILINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two full size samples illustrating material and finish of acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 2 percent of total installed.

#### 1.5 QUALITY ASSURANCE

- A. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 1.6 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

### PART 2 PRODUCTS

#### 2.1 ACOUSTICAL UNITS

- A. Acoustical Tile: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
  - 1. Size: 24 by 24 inches.
  - 2. Thickness: 3/4 inches.
  - 3. Edge: Square.
  - 4. Surface Color: White.
  - 5. Suspension System: Exposed grid.
  - 6. Products:
    - a. Match existing tile.



- b. Substitutions: Not permitted.

## 2.2 SUSPENSION SYSTEM

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
  - 1. Profile: Tee; 15/16 inch wide face.
  - 2. Finish: White painted.
  - 3. Products:
    - a. USG; Donn DX/DXL.
    - b. Substitutions: Not permitted.

## 2.3 ACCESSORIES

- A. Perimeter Moldings: Same material and finish as grid.
  - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### 3.2 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM C636/C636M, and ASTM C636/C636M and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Do not attach suspension system directly to metal roof deck, unless indicated otherwise.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support light fixtures and mechanical components using supplementary hangers located within 6 inches ( 150 mm ) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

### 3.3 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.
- 3.4 TOLERANCES
- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
  - B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

## SECTION 09 65 00 - RESILIENT FLOORING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Installation accessories.

#### 1.2 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2019, with Editorial Revision (2020).
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile 2004 (Reapproved 2018).
- C. ASTM F1861 - Standard Specification for Resilient Wall Base 2016.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 2 by 2 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Flooring Material: 1 package of each type and color.
  - 3. Extra Wall Base: 20 linear feet of each type and color.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials off of the floor in an acclimatized, weather-tight space.
- B. Protect roll materials from damage by storing on end.

#### 1.5 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 .

### PART 2 PRODUCTS

#### 2.1 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
  - 1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  - 2. Size: 12 by 12 inch.
  - 3. Thickness: 0.125 inch ( 3.2 mm ).
  - 4. Color: As selected by Architect from Manufacturer's full range.
  - 5. Manufacturers:
    - a. Armstrong World Industries, Inc; Standard Excellon: [www.armstrong.com](http://www.armstrong.com).
    - b. Mannington Mills, Inc; Touchstone: [www.mannington.com](http://www.mannington.com).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.2 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
  - 1. Thickness: 0.125 inch thick.
  - 2. Finish: Satin.
  - 3. Length: Roll.

4. Color: Match existing base color.
5. Manufacturers:
  - a. Roppe Corp; Pinnacle Rubber Base: [www.roppe.com](http://www.roppe.com).
  - b. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.3 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: rubber.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

### 3.2 PREPARATION

- A. Clean substrate.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Fit joints tightly.

### 3.4 TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

### 3.5 RESILIENT BASE

- A. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- B. Scribe and fit to door frames and other interruptions.

### 3.6 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.
- C. Apply final coat of wax as recommended by manufacturer.

### 3.7 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

## SECTION 09 91 23 - INTERIOR PAINTING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Floors, unless specifically indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

#### 1.2 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
- C. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- D. SSPC-SP 6 - Commercial Blast Cleaning 2007.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
  - 2. Where sheen is not specified, submit each color in each sheen available.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.

3. Label each container with color in addition to the manufacturer's label.
- 1.4 MOCK-UP
    - A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
    - B. Provide panel, minimum 5 feet long by 5 feet wide, illustrating paint color, texture, and finish.
    - C. Locate where directed by Architect.
    - D. Mock-up may remain as part of the work.
  - 1.5 DELIVERY, STORAGE, AND HANDLING
    - A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
    - B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
    - C. Paint Materials: Store at minimum ambient temperature of 45 degrees and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
  - 1.6 FIELD CONDITIONS
    - A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
    - B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
    - C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  1. Behr Process Corporation: [www.behr.com/#sle](http://www.behr.com/#sle).
  2. PPG Paints: [www.ppgpaints.com/#sle](http://www.ppgpaints.com/#sle).
  3. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
  1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI categories, except as otherwise indicated.
  2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.

5. Supply each paint material in quantity required to complete entire project's work from a single production run.
  6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- C. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
  2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
  3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
  4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

### 2.3 PAINT SYSTEMS - INTERIOR

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board.
1. Two top coats and one coat primer.
  2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
  3. Top Coat Sheen:
    - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
- B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include doors and door frames.
  2. Two top coats and one coat primer.
  3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153 or 154.
  4. Top Coat Sheen:
    - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

### 2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

### 3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION



## SECTION 11 53 13 - LABORATORY FUME HOODS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Standard laboratory fume hoods.
- B. Fume hood base cabinets and stands.
- C. Work surfaces.
- D. Laboratory cup sinks in fume hoods.
- E. Service fittings and outlets.
- F. Airflow indicators and alarms.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring fume hoods.
- B. Section 09 65 00 - Resilient Flooring: Resilient base applied to base cabinets.
- C. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Field quality-control testing of fume hoods.

#### 1.3 REFERENCE STANDARDS

- A. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods 2016.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2019.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable 2018.
- E. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals 2015.
- F. SEFA 1 - Laboratory Fume Hoods 2010.
- G. SEFA 2 - Installations 2010.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide fume hood exterior and interior dimensions and construction, utility and service requirements and locations.
- C. Shop Drawings: Indicate locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, locations and types of service fittings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Provide documentation of successful Factory Acceptance Testing.
- E. Operation Data: Include description of equipment operation and required adjusting and testing.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year manufacturer warranty for manufacturer's standard items (listed by part number in manufacturer's official publication).

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Laboratory Fume Hoods:
  - 1. Kewaunee Scientific Corp: [www.kewaunee.com/#sle](http://www.kewaunee.com/#sle).
  - 2. Mott Manufacturing Ltd: [www.mott.ca/#sle](http://www.mott.ca/#sle).
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide laboratory fume hoods from single manufacturer.

#### 2.2 CONSTANT AIR VOLUME (CAV) FUME HOODS

- A. Bypass Fume Hoods:
  - 1. Include a built-in compensating bypass arrangement to maintain constant exhaust volume regardless of sash position.

#### 2.3 PERFORMANCE REQUIREMENTS

- A. Fume hoods complying with the following when tested in accordance with ASHRAE Std 110:
  - 1. As-Manufactured (AM) Rating: AM 0.01 (0.01 ppm).
  - 2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
  - 3. Average Face Velocity: 100 FPM (0.51 m/s) plus or minus 10 percent with sashes fully open.
  - 4. Face-Velocity Variation: Not more than 10 percent of average face velocity across the face opening with sash(es) fully open.
  - 5. Release Rate: 4.0 L/min.
  - 6. Static-Pressure Loss: Not more than 1/2-inch w.g. (124 Pa) at 100 FPM (0.51 m/s) face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

#### 2.4 FUME HOODS

- A. General Requirements:
  - 1. Comply with SEFA 1.
- B. Fume Hood:
  - 1. Ventilation: Constant Air Volume (CAV).
  - 2. Configuration: Standing-height; bench mounted.
  - 3. Nominal Interior Height: 48 inches.
  - 4. Sash Type: Vertical rising.
    - a. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
    - b. Glazing: Polycarbonate.
    - c. Sash Guides: Corrosion-resistant polyvinyl chloride (PVC) track.
    - d. Vertical Sash mechanism: Designed to prevent sash drop in case of mechanism failure.
      - 1) Chain: Hardened chain, standard with the manufacturer.
        - (a) Sprocket system for Sash Chain: Hardened sprockets with one full-width shaft per sash, running in ball-bearings.

- e. Vertical Sash Pull: Type 316 stainless steel, with No.4 finish.
- 5. Top Front Panel: Standard integral grille stamped into panel of same materials as fume hood exterior.
- 6. Exterior: Sheet steel.
  - a. Color/Finish: To match laboratory casework .
- 7. Interior Lining: Polypropylene.
- 8. Service Fittings and Fixtures:
  - a. Cup Sink : Drop-in Epoxy, complete with removable stainer and waste fitting.
    - 1) Shape: Oval.
    - 2) Size: 3 inches by 9 inches (75 by 228 mm).
  - b. Natural Gas Fitting Assembly: Manufacturer's standard.
  - c. Specialty Gas Fitting Assembly: Manufacturer's standard.
  - d. Compressed Air Outlet Fitting Assembly: Manufacturer's standard.
  - e. Vacuum Outlet Fitting Assembly: Manufacturer's standard.
  - f. Water Outlet Fitting Assembly: Manufacturer's standard.
  - g. Escutcheons: Stainless steel.
- 9. Access Panels: Provide removable panels on both sides hood exterior and interior lining panels.
- 10. Work Surface:
  - a. Work Top for Fume Hoods Other Than Floor-mounted Type: Epoxy resin.
    - 1) Edge: Raised rim with rounded edges and corners.
- C. Fume Hood Base Cabinets:
  - 1. Exterior construction: Metal cabinets.
    - a. Standard storage cabinets.
  - 2. Material: Sheet steel.
  - 3. Color/Finish: Matching fume hood finish.
- D. Light Fixtures: UL labeled, vaporproof, one-tube, T-5 fluorescent light fixtures. Number and length of fixtures as necessary for fume hood width. Mounted above sealed safety glass panel. White baked-enamel finish on fixture interior.

## 2.5 FABRICATION

- A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations, or as necessary to permit movement through a 35 inches by 79 inches ( 889 mm by 2007 mm ) clear door opening.
- B. Ends: Fabricated with double-wall end panels. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
- C. Lining Assembly: Unless otherwise indicated, assembled with stainless-steel fasteners or epoxy adhesive, concealed where possible. Joints sealed by filling with chemical-resistant sealant during assembly.
  - 1. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.
- D. Rear Baffle: Same material as fume hood lining, unless otherwise indicated, at rear of hood with openings at top and bottom, with corrosion-resistant fasteners. Fabricated for removal to facilitate cleaning behind baffle.
- E. Exhaust Plenum: Full width of fume hood, sized and configured to provide uniform airflow, of same material as hood lining, and with duct stub for exhaust connection.

1. Duct-Stub Material: Epoxy-coated steel, unless otherwise indicated.
- F. Airfoil: At bottom of fume hood face opening, with 1 inch ( 25.4 mm ) gap between bottom of airfoil and work top. Sash to close on top of airfoil. Designed to direct airflow across work.
  1. Fabricated from 14 gage, 0.0781 inch ( 1.98 mm ) stainless steel with No.4 finish.
- G. Comply with requirements of other sections for factory installation of water and laboratory gas service fittings, piping, electrical devices, and wiring. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated.

## 2.6 MATERIALS

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Fasteners: Stainless-steel, where exposed to fumes.

## 2.7 ACCESSORIES

- A. Airflow Monitors/Indicators and Alarms: Provide each fume hood with a airflow monitor/indicator complete with an audible and visual alarm that activates when airflow sensor reading is outside of preset range.
  1. Source: Fume hood manufacturer.
  2. Airflow Monitor/Indicator Functionality:
    - a. Type: A sensor module that monitors fume hood face airflow velocity, and a display module that indicates whether velocity it is below normal, normal, or above normal.
  3. Airflow Alarm functionality: Audible (85 dB @ 4 inch ( 102 mm ) distance), and visual alarm that activates when airflow sensor reading is outside of preset range.
    - a. Reset and test mode.
    - b. Programmable Switch: Designed to silence audible alarm and automatically reset when airflow returns to within preset range. Warning light to stay on when alarm is silenced.
    - c. Capability for integration with BAS (Building Automation System) via BACnet.
- B. Sash Stops: Spring-loaded stops to limit hood opening to 50 percent of sash height. Manually releasable to open sash fully, and to reset automatically when sash is lowered below set level.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely

anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

- B. Comply with indicated requirements for installing water and laboratory gas service fittings, and electrical and telecommunications devices.
  - 1. Install fittings in accordance with shop drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods.

### 3.3 FIELD QUALITY CONTROL

- A. Field test fume hoods as specified below.
  - 1. General: Test fume hoods as installed to assess airflow velocity. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for hoods provided in the Project.
  - 2. Preparation:
    - a. Inspect each fume hood to confirm its installation complies with drawings and specifications.
    - b. Inspect laboratory space to verify that construction complies with drawings and specified requirements.
    - c. Do not proceed with fume hood testing until an acceptable TAB report has been received.

### 3.4 CLEANING

- A. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

### 3.5 DEMONSTRATION

- A. Demonstrate proper operation of fume hoods and their accessories to Owner's designated representative.

END OF SECTION

## SECTION 12 35 53.13 - METAL LABORATORY CASEWORK

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Standard and custom metal cabinets and cabinet hardware.
- B. Tables.
- C. Wall shelving.
- D. Countertops.
- E. Laboratory sinks.
- F. Pegboards.
- G. Laboratory emergency equipment plumbing fixtures.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- C. Section 09 65 00 - Resilient Flooring: Resilient wall base.

#### 1.3 DEFINITIONS

- A. Adaptable Laboratory Furniture System: Modular furniture assemblies consisting of individual components, including: support structures; cabinets and storage units; worksurfaces; shelving; accessories.

#### 1.4 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment 2014.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable 2018.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings 2017.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- G. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- H. SEFA 1 - Laboratory Fume Hoods 2010.
- I. SEFA 2 - Installations 2010.
- J. SEFA 3 - Laboratory Work Surfaces 2010.
- K. SEFA 7 - Laboratory Fixtures 2010.
- L. SEFA 8M - Laboratory Grade Metal Casework 2016.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of casework with related items.
  - 1. Service Fixtures: Coordinate location and characteristics of service connections.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

#### 1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Details of materials, component dimensions and configurations, construction details, joint details, attachments; manufacturer's catalog literature on

hardware and keying, accessories, and service fittings, if any.

- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
- D. Test Reports: Independent laboratory reports showing compliance with chemical and physical resistance requirements for casework finish.
- E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- F. Finish touch-up kit for each type and color of materials provided.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

#### 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
  - 1. Ruptured, cracked, or stained finish coating.
  - 2. Discoloration, or lack of finish integrity.
  - 3. Cracking or peeling of finish.
  - 4. Weld or any other structural failure.
  - 5. Failure of hardware.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Metal Laboratory Casework:
  - 1. Kewaunee Scientific Corp: [www.kewaunee.com/#sle](http://www.kewaunee.com/#sle).
  - 2. LOC Scientific: [www.locscientific.com/#sle](http://www.locscientific.com/#sle).
  - 3. Mott Manufacturing Ltd: [www.mott.ca/#sle](http://www.mott.ca/#sle).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Countertops:
  - 1. Durcon (Epoxy resin, Solid phenolic): [www.durcon.com/#sle](http://www.durcon.com/#sle).
  - 2. Trespa (Solid phenolic): [www.trespa.com/#sle](http://www.trespa.com/#sle).
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Sinks and Cup Sinks:
  - 1. Durcon (Epoxy resin, Polyolefin): [www.durcon.com/#sle](http://www.durcon.com/#sle).
  - 2. Scientific Plastics, Inc. (Polyolefin): [www.scientificplastics.com/#sle](http://www.scientificplastics.com/#sle).
  - 3. Substitutions: See Section 01 60 00-Product Requirements.
- D. Water and Gas Service Fittings:
  - 1. Broen-Lab A/S: [www.broen-lab.com/#sle](http://www.broen-lab.com/#sle).
  - 2. Chicago Faucets, a Geberit company: [www.chicagofaucets.com/#sle](http://www.chicagofaucets.com/#sle).
  - 3. WaterSaver Faucet Co: [www.wsflab.com/#sle](http://www.wsflab.com/#sle).

4. Substitutions: See Section 01 60 00 - Product Requirements.
- 2.2 METAL LABORATORY CASEWORK
- A. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
1. Style: Flush overlay - square edge.
  2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions.
    - a. Base Cabinets: 22 inch
  3. Steel Sheet Metal:
    - a. Gables, Front and Back Panels, Gusset Plates, Aprons, and Rails: 18 gage, 0.0478 inch minimum thickness.
    - b. Drawers, Cabinet Floors, Shelves, Filler Panels and Drawer Dividers: 20 gage, 0.0359 inch minimum thickness.
    - c. Backing Sheet to Door and Door Fronts: 22 gage, 0.0299 inch minimum thickness.
  4. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7 and SEFA 8M, provide components that safely support the following minimum loads, without deformation or damage:
    - a. Base Units: 500 pounds per linear foot across the cabinet ends.
    - b. Tables: 300 pounds on four legs.
    - c. Drawers: 125 pounds.
    - d. Shelves: 100 pounds.
  5. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
  6. Edges and Seams: Smooth. Form counter tops, shelves, and drain boards from continuous sheets.
  7. Shelf Edges: Turned down 3/4 inch on each side and returned 3/4 inch front and back.
  8. Ends: Close open ends with matching construction.
  9. Welding: Electric spot welded; joints ground smooth and flush.
  10. Drawers and Doors: Fabricate drawer and door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware.
  11. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials, and to separate dissimilar metals.
- B. Tables: Fabricated from formed metal skirting panels welded into a rigid frame. Corners notched and reinforced to receive manufacturer's standard square metal tubular legs, bolted securely in place, 3/8 inch leveling devices, and slip-on type black PVC shoes.
- C. Wall Shelving: At locations indicated.
1. Adjustable Shelf Supports: Standard back-mounted system using single-slotted surface mounted metal shelf standards, in lengths indicated, with coordinated cantilevered shelf brackets, No.4 finish, designed for nominal 1 inch spacing adjustments.
  2. Shelves: 1 inch steel shelves in lengths indicated.
    - a. Depth: 12 inch.



## 2.3 CABINET HARDWARE

- A. Manufacturer's standard styles.
- B. Conform to BHMA A156.9 requirements.
  - 1. Acceptable base materials for plated finishes include brass, bronze, and steel.
- C. Finish of exposed stainless steel components: No.4 finish.

## 2.4 COUNTERTOPS

- A. Countertops:
  - 1. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
    - a. Flat Surface Thickness: 1 inch, nominal.
    - b. Surface Finish: Smooth, non-glare.
    - c. Color: Black.
    - d. Exposed Edge Shape: 3/16 inch radius corner.
    - e. Back and End Splashes: Same material, same thickness; separate for field attachment.

## 2.5 SINKS

- A. Laboratory sinks.
  - 1. General: Sinks with perimeter lip for drop-in installation.
  - 2. Sink : Single-bowl.
    - a. Basis of Design: Model D55 manufactured by Laboratory Tops, Inc..
    - b. Material: Epoxy.
    - c. Mounting: Drop-in.
    - d. Size: 25 inch wide by 15 inch front-to-back by 10 inch deep.

## 2.6 PEGBOARDS

- A. Epoxy pegboards with pre-drilled or punched holes in a staggered pattern, designed to accept removable black polypropylene pegs. With each pegboard include a stainless steel drip-trough with drain outlet and matching diameter 36 inch ( 914 mm ) long PVC drain hose.
  - 1. Size: 30 inches wide by 30 inches high ( 762 mm wide by 762 mm high ).

## 2.7 LABORATORY EMERGENCY EQUIPMENT PLUMBING FIXTURES

- A. General: Provide emergency equipment products complying with requirements of ANSI Z358.1.
- B. Eye/Face Wash Units: Deck-mounted units.
  - 1. Construction: Polished chrome-plated brass.
  - 2. Twin eyewash heads with pop-off dust covers, internal flow control, and filter.
  - 3. Type: 90-Degree horizontal-swivel, designed for mounting at either side of sink, with flag-handle activation.
    - a. Plug-type valve designed to open orifice and activate water flow only when unit is swung down into operational position.
  - 4. Sign: Manufacturer's standard ANSI-compliant identification sign.

## 2.8 SERVICE FITTINGS

- A. General: Comply with requirements of SEFA 7.
- B. Water Service Fittings and Fixtures.
  - 1. Water, Mixing Faucet :
    - a. Basis of Design: Model L412VB manufactured by Water Saver Faucet Co..

- b. Valve: Forged or cast brass body, 180 degree inlet - outlet configuration, with polished chrome finish.
- c. Provide vacuum breaker.
- d. Gooseneck: Rigid gooseneck, with 6 inch ( 153 mm ) spread, anti-splash serrated hose end.
- e. Handles: Manufacturer's standard color-coded molded nylon hooded handle with color-coded index disc.

2. Escutcheons: Polished chrome.

## 2.9 FINISHES

- A. Sheet Steel Finish: Having chemical resistance equal to Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8M. Test applied finishes using procedures specified in ASTM D522/D522M.
  1. Coating Type, New Casework: Baked on epoxy; minimum two coats.
  2. Color: Match existing Owner provided cabinets..
  3. Preparation: Degrease and phosphate etch, and prime.

## 2.10 ACCESSORIES

- A. Undercabinet Task-Light Luminaires: LED luminaires, with switch and heavy-duty cord and plug.
  1. Length: 18 inches, nominal.
  2. Illumination: 1300 lumens, minimum.
  3. Lens: Clear acrylic.
  4. Finish: Baked enamel.
  5. Color of Housing: Selected from manufacturer's standard range.
- B. Gas Cylinder Brackets: Restraint safety assemblies for laboratory gas cylinders.
  1. Regulatory Compliance: OSHA and NFPA.
  2. Bracket Mounting: Wall, with fasteners.
  3. Cylinder Capacity: Two
  4. Cylinder Diameter Capability: 4 to 12 inches ( 102 to 305 mm ).
  5. Bracket Construction: 11 gage, 0.119 inch ( 3.04 mm ) hot-rolled steel.
    - a. Metal Bracket Edge Protection: Steel-reinforced vinyl edge guard.
  6. Steel Finish: Polyester powder-coat.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify adequacy of support framing and anchors.
- B. Verify that service connections are correctly located and of proper characteristics.

### 3.2 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure, with no distortion.
  1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch ( 19 mm ) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make

level and plumb first cabinet in relation to this high point.

- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch ( 1.6 mm ). In addition, do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch ( 1.6 mm ) in 10 feet ( 3 m ).
  - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch ( 3 mm ) in 10 feet ( 3 m ).
  - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch ( 0.8 mm ).
  - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch ( 1.6 mm ).
- F. Separate dissimilar metals to prevent galvanic action.
- G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches ( 407 mm ) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- H. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- I. Replace units that are damaged, including those that have damaged finishes.

END OF SECTION

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## SECTION 21 05 00 - GENERAL PROVISIONS FOR FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 CHECKING DOCUMENTS:

- A. The drawings and the specifications are numbered consecutively. The Contractor shall check the drawings and specifications thoroughly and shall notify the Architect of any discrepancies or omissions of sheets or pages. Upon notification, the Architect will promptly provide the Contractor with any missing portions of the drawings or specifications. No discrepancies or omissions of sheets or pages of the contract documents will relieve the Contractor of his duty to provide all work required by the complete contract documents.

#### 1.3 SUMMARY

- A. This Section includes the following:
  - 1. General Provisions for Construction
  - 2. Piping materials and installation instructions common to most piping systems.
  - 3. Sleeves.
  - 4. Escutcheons.
  - 5. Painting and finishing.
  - 6. Supports and anchorages.
  - 7. Close-out Documents and Requirements

#### 1.4 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install," "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.
- B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. The use of the word "shall" conveys a mandatory condition to the contract.

- D. "This section" always refers to the section in which the statement occurs.
- E. "The project" includes all work in progress during the construction period.
- F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.
- G. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- I. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- K. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- L. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.5 GENERAL:

- A. In general, the lines to be installed under these specifications shall be run as indicated, as specified herein, as required by particular conditions at the site, and as required to conform to the generally accepted standards as to complete the work in a neat and satisfactorily workable manner. The following is a general outline concerning the running of various lines and ducts and is to be excepted where the drawings or conditions at the building necessitate deviating from these standards.
- B. All piping shall be concealed except where protection of exposed structure is required. In exposed areas all piping shall be located as close to roof structure as allowed by NFPA. Coordinate piping with all other trades. All other trades shall have precedent over fire sprinkler piping. Sprinkler piping shall be rerouted to avoid conflicts. Shop drawings shall show all piping locations, heights and head locations. Architect shall reserve the right to require any piping that is not installed per these requirements to be rerouted.
- C. All piping shall be concealed in chases in finished areas, except as indicated on the drawings. Horizontal lines run in areas that have ceilings shall be run concealed in those ceilings, unless otherwise specifically indicated or directed.

- D. Piping may be run exposed in machinery and equipment spaces, where serving as connections to equipment items in finished rooms where exposed connections are required, and elsewhere as indicated on the drawings or required.
- E. The Contractor shall thoroughly acquaint himself with the details of the construction and finishes before submitting his bid as no allowances will be made because of the Contractor's unfamiliarity with these details. Place all inserts in masonry walls while they are under construction. All concealed lines shall be installed as required by the pace of the general construction to precede that general construction.
- F. The Contractor shall carefully lay out his work at the site to conform to the architectural and structural conditions, to provide proper grading of lines, to avoid all obstruction, to conform to details of installation supplied by the manufacturers of the equipment to be installed, and thereby to provide an integrated, satisfactorily operating installation.
- G. The mechanical and electrical plans do not give exact locations of outlets, fixtures, equipment items, etc. The exact location of each item shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with other sections. Minor relocations necessitated by the conditions at the site or as directed by the Architect shall be made without any additional cost accruing to the Owner.
- H. The Contractor shall be responsible for the proper fitting of his material and apparatus into the space. Should the particular equipment which any bidder proposes to install require other space conditions than those indicated on the drawings, he shall arrange for such space with the Architect before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make such necessary changes at his (the Contractor's) own expense.
- I. Order of precedence shall be observed in laying out the pipe, ductwork, material, and conduit in order to fit the material into the space above the ceiling and in the chases and walls. The following order shall govern:
  - 1. Items affecting the visual appearance of the inside of the building such as lighting fixtures, diffusers, grilles, outlets, panelboards, etc. Coordinate all items to avoid conflicts at the site.
  - 2. Lines requiring grade to function such as sewers.
  - 3. Large ducts and pipes with critical clearances.
  - 4. Conduit, water lines, and other lines whose routing is not critical and whose function would not be impaired by bends and offsets.
- J. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention before the contract is signed. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus, material, or equipment.
- K. The Contractor shall distinctly understand that the work described herein and shown on the accompanying drawings shall result in a finished and working job, and any item required to accomplish this intent shall be included whether specifically mentioned or not.

- L. Each bidder shall examine the plans and specifications for the General Construction. If these documents show any item requiring work under Division 21 and that work is not indicated on the respective fire protection or plumbing drawings, he shall notify the Architect in sufficient time to clarify before bidding. If no notification is received, the Contractor is assumed to require no clarification, and shall install the work as indicated on the General Plans in accordance with the specifications.

1.6 DIMENSIONS:

- A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings. Any difference which may be found shall be submitted to the Architect for consideration before proceeding with the work.

1.7 INSPECTION OF SITE:

- A. The accompanying plans do not indicate completely the existing installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.8 SUBMITTALS

- A. Wherever shop drawings are called for in these specifications, they shall be furnished by the Contractor for the work involved after review by the Architect as to the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary details. Also, if the Contractor fails to comply with this provision, the Architect reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary and should there be any charges in connection with this, they shall be borne by the Contractor. No work shall begin until the Architect/Engineer have approved the shop drawings.
- B. Shop drawings will be reviewed by the Architect for general compliance with the design concept of the project and general compliance with the information given in the contract documents. Review by the Architect and any action by the Architect in marking shop drawings is subject to the requirements of the entire contract documents. Contractor will be held responsible for quantities, dimensions which shall be confirmed



and correlated at the job site, fabrication processes and techniques of construction, coordination of all trades and the satisfactory performance of his work.

- C. Shop drawings submitted shall not consist of manufacturers' catalogues or tear sheets therefrom that contain no indication of the exact item offered. Rather, the submission of individual items shall designate the exact item offered and shall clearly identify the item with the project.
- D. All shop drawings shall be submitted at one time and shall consist of a bound catalogue of all shop drawings under each section, properly indexed and certified that they have been checked by the Contractor.
- E. The omissions of any material from the shop drawings which has been shown on the contract drawings or specified, even though reviewed by the Architect, shall not relieve the Contractor from furnishing and erecting same.
- F. Product Data: For the following:
  - 1. Escutcheons.
  - 2. Material indicated in other Division 21 Sections.

#### 1.9 QUALITY ASSURANCE

- A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.10 LAWS, CODES AND ORDINANCES:

- A. All work shall be executed in strict accordance with all local, state and national codes, ordinances and regulations governing the particular class of work involved, as interpreted by the inspecting authority. The Contractor shall be responsible for the final execution of the work under this heading to suit those requirements. Where these specifications and the accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect, shall prepare any supplemental drawings required illustrating how the work may be installed so as to comply and, on approval, make the changes at no cost to the Owner. On completion of the various portions of the work the installation shall be tested by the constituted authorities, approved and, on completion of the work, the Contractor shall obtain and deliver to the Owner a final certificate of acceptance.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Refer to other Division 21 Sections for additional requirements.

1.12 GUARANTEE:

- A. Unless a longer guarantee is hereinafter called for, all work, material and equipment items shall be guaranteed for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect, shall be repaired and/or replaced to the complete satisfaction of the Architect. Guarantee shall be in writing and in triplicate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
    - a. Where a definite material is mentioned in these specifications, it has been done in order to establish a standard. The product of the particular manufacturer mentioned is of satisfactory construction and any substitution must be of quality as good as or better than the named article. No substitution shall be made without review by the Architect, who will be the sole judge of equality.
    - b. Should a substitution be accepted under the provisions of the conditions of these specifications, and should this substitute prove to be defective or otherwise unsatisfactory for the service for which it is intended within the guarantee period, the Contractor who originally requested the substitution shall replace the substitute material with the specified material.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

### 2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

### 2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.

- 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

### PART 3 - EXECUTION

#### 3.1 RELOCATION OF EXISTING INSTALLATIONS:

- A. There are portions of the existing fire suppression system which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations which must be relocated to avoid interferences with the installations of new work of his particular trade and that of all other trades. All such existing installations which interfere with new installations shall be relocated by the Contractor under the Division in which the existing material normally belongs, and in a manner as directed by the Architect.
- B. Failure to become familiar with the extent of the relocation work involved shall not relieve the Contractor of responsibility and shall not be used as a basis for additional compensation.

#### 3.2 ACCESS PANELS:

- A. Wherever valves or other components are installed and access is required through either walls or ceilings and such cannot be obtained through the removable ceiling or through other means, the Contractor shall provide Milcor Style "M" access doors at least 12 inches by 12 inches in size or larger if required for access. Provide rated access panels as required for installation in rated construction.

#### 3.3 USE OF SYSTEM:

- A. In general, the fire suppression systems shall be installed in a timely manner, at a pace consistent with the general construction, but shall then be made operational as soon as practicable to provide protection during the remainder of construction. Where underground service lines and hydrants are included in the project, they shall be installed, completed, and placed in service prior to construction work. Water service lines shall be extended to the building and made available prior to the delivery of any combustible building materials.

- B. The use of the equipment and system for providing building fire protection shall in no way constitute acceptance of that equipment and the connected piping by the Owner. Furthermore, it shall in no way shorten the guarantee period hereinafter specified. The Contractor shall either secure extended warranties from the vendors of equipment or shall purchase insurance to provide proper coverage on the equipment through the guarantee period and shall file with the Architect substantiating affidavits from equipment manufacturers or a copy of the insurance policy covering the equipment through the guarantee period. The personal underwriting of the Contractor for equipment manufacturers' warranties is not acceptable, but his personal underwriting of piping, ductwork, insulation and associated materials is acceptable subject to the provisions of the contract.

#### 3.4 OWNERS OCCUPANCY:

- A. It shall be understood that the building in which the work is to be done is a necessary part of the Owner's operation, and shall continue in use throughout the construction period without interruption. Take all precautions required by the Owner for the protection of his equipment and property.
- B. Contractor shall cooperate with the owner in scheduling areas in which work is permitted. Owners schedule will govern.

#### 3.5 SCHEDULE OF WORK:

- A. The Contractor shall program his work in such manner as to interfere as little as possible with the normal routine of the Owner. It must be understood that the Owner will continue to function throughout the construction period. All water and sanitary facilities shall therefore be continued in operation with a minimum of interruption and the Contractor shall make any temporary connections necessary to comply with this requirement.
- B. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to insure meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates, schedule the times of work in the various areas involved, etc. Each Contractor shall cooperate in establishing these times and locations and shall process his work so as to insure the proper execution of it.
- C. Under no condition shall any work be done in the present building that would interfere with its natural use during its normal hours of occupancy, unless special permission is granted by the Owner. This is particularly applicable where new connections are to be made to present lines or items of equipment in that building or where present equipment items in that building are to be relocated or modified in any way. The Contractor shall include this scheduling requirement in his proposal as no additional compensation for overtime work will be granted.

3.6 WORKING TIME:

- A. Where new connections are to be made into existing lines, present lines must be relocated or rerouted, present equipment items relocated or other work accomplished that would affect the operation of the present building, the work shall be carried on at such times as to cause a minimum of interference with the normal operation of that building. In certain cases the work may be accomplished during normal working hours during certain designated seasons or times of the year. In other cases the work may have to be executed during times of the day outside of the normal working period, on holidays, etc. Each individual case presents a separate decision as to the time during which it shall be performed. The Contractor involved shall present each case to the Architect for his decision, which will be made after due consultation with the Owner. No additional compensation for overtime will be granted for compliance with these requirements.

3.7 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Fire sprinkler piping shall not be supported with hangers of other trades, and in no way shall be used to support the work of other trades. Hangers for fire sprinkler piping shall be independent of all other supports.
- K. Select system components with pressure rating equal to or greater than system operating pressure.

- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - d. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
    - e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    - f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.8 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.



3.9 ELECTRICAL WIRING:

- A. All electric wiring of every character, shall be done under Divisions 26 and 27 of these specifications. The Contractor for each section shall erect all his motors in place ready for connections. The Contractor, under Division 26, shall mount all the starters and controls, furnishing the supporting structures and any required outlet boxes.
- B. Every electrical current consuming device furnished as a part of this project, or furnished by the Owner and installed in this project, shall be completely wired up under Divisions 26 and 27. Verification of exact location, method of connection, number and size of wires required, voltage requirements, and phase requirements is the responsibility of the Contractor under Divisions 26 and 27. If conflicts occur between the drawings and the actual requirements, actual requirements shall govern.

3.10 SEALING AROUND PIPES

- A. The Contractor installing pipes shall seal all spaces between pipes and/or sleeves where they pierce walls, partitions or floors with Johns-Manville Firetemp CI intumescent caulk or as directed by architect. The packing shall effect a complete fire and/or air seal where pipes, ducts, etc., pierce walls, floors or partitions.

3.11 PROGRESS OF WORK:

- A. The Contractor shall keep himself fully informed as to the progress of the work and do his work at the proper time without waiting for notification from the Architect or Owner.

3.12 COORDINATION

- A. The Contractor shall be responsible for resolving all coordination required between trades. For example, items furnished under Division 21 which require electrical connections shall be coordinated with Divisions 26 or 27 for:
  - 1. Voltage
  - 2. Phase
  - 3. Ampacity
  - 4. No. and size of wires
  - 5. Wiring diagrams
  - 6. Starter size, details and location
  - 7. Control devices and details
- B. Items installed in/on finished ceilings shall be coordinated with the ceiling construction. The Contractor under each section shall conform to the reflected ceiling plan and shall secure details and/or samples of the ceiling materials as necessary to insure compatibility. Any device not conforming to this requirement shall be replaced by the Contractor at his expense.
- C. All items specified under Division 21 shall be installed tight, plumb, level, square and symmetrically placed in relation to the work of other trades.

- D. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire sprinkler installations.
- E. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- F. Coordinate location and elevation of pipe with all other contractors such that required service areas shall not be encroached upon. Any piping found to be limiting service access to components installed by other contractors shall be removed and rerouted at no cost to the owner.

3.13 MANUFACTURER'S DIRECTIONS:

- A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer.

3.14 MATERIALS AND WORKMANSHIP:

- A. All materials shall be new unless otherwise specified and of the quality specified. Materials shall be free from defects. All materials of a type for which the Underwriters Laboratories, Inc. have established a standard shall be listed by the Underwriters Laboratories, Inc. and shall bear their label.
- B. Wherever the make of material or apparatus required is not definitely specified, the Contractor shall submit a sample to the Architect before proceeding.
- C. The Architect reserves the right to call for samples of any item of material offered in substitution, together with a sample of the specified material, when, in the Architect's opinion, the quality of the material and/or the appearance is involved and it is deemed that an evaluation of the two materials may be better made by visual inspection. This shall be limited to plumbing brass, grilles, registers, ceiling outlets and similar items and shall not be applicable to major manufacturers' items of equipment.
- D. The Contractor shall be responsible for transportation of his materials to and on the job, and shall be responsible for the storage and protection of these materials and work until the final acceptance of the job.
- E. The Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds, and all labor required for the safe and expeditious execution of his contract.
- F. The workmanship shall in all respects be of the highest grade and all construction shall be done according to the best practice of the trade.

3.15 COOPERATION AND CLEANING UP:

- A. The contractor for the work under each section of these specifications shall coordinate his work with the work described in all other sections of the specifications to the end

that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.

- B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

### 3.16 TESTING:

- A. The Contractor under each division shall at his own expense perform the various tests as specified and required by the Architect and as required by the State and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests. Notify the Architect a minimum of 24 hours in advance of all tests.

### 3.17 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.18 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

### 3.19 INSTALLATION DRAWINGS:

- A. It shall be incumbent upon the Contractor to prepare special drawings as called for elsewhere herein or as directed by the Architect to coordinate the work under each section, to illustrate changes in his work, to facilitate its concealment in finished spaces to avoid obstructions or to illustrate the adaptability of any item of equipment which he proposes to use.
- B. These drawings shall be used in the field for the actual installation of the work. Unless otherwise directed, they shall not be submitted for approval but three copies shall be provided to the Architect for his information.

3.20 OPERATING INSTRUCTIONS:

- A. The Contractor for each section of the work hereunder shall, in cooperation with the representatives of the manufacturers of the various equipment items, carefully instruct the Owner's representatives in the proper operation of each item of equipment and of each system. During the balancing and adjusting of systems, the Owner's representative shall be made familiar with all procedures.
- B. The contractor shall coordinate the date and time for the training with the Owner's representative and shall document attendance with a sign-in sheet. At a minimum, the sign-in sheet shall indicate the date and location of the session, name and organization of each participant, and a list of any material that may be provided. This information shall be provided to the Architect as part of the closeout documents. Failure to provide documentation of training may require the contractor to provide a subsequent training session.

3.21 OPERATING MANUALS:

- A. Prepare and submit 3 copies of the operating manuals bound in hard covers. Three weeks prior to completion of the work, the Architect will check the manuals and any additional material necessary to complete the manuals shall be furnished and inserted by the Contractor.
- B. Manuals shall contain the following data:
  - 1. Catalogue data of all equipment.
  - 2. Shop drawings of all equipment.
  - 3. Temperature control drawings (reduced in size)
  - 4. Start-up instructions for major equipment.
  - 5. Trouble shooting procedures for major equipment.
  - 6. Wiring diagrams.
  - 7. Recommended maintenance schedule for equipment.
  - 8. Parts list for all items.
  - 9. Name and address of each vendor.

3.22 COMPLETION REQUIREMENTS:

- A. Before acceptance and final payment the Contractor under each Division of the specifications shall furnish:
  - 1. Accurate record drawings, shown in red ink on blue line prints furnished for that purpose all changes from the original plans made during installation of the work. Drawings shall be filed with the Architect when the work is completed.
  - 2. All manufacturers' guarantees.
  - 3. All operating manuals.
  - 4. Guarantees.

3.23 CONTRACTOR'S RESPONSIBILITY FOR FINAL INSPECTION:

- A. Before calling for the final inspection, the Contractor under each Division shall carefully inspect his work to be sure it is complete and according to plans and specifications.

END OF SECTION 21 05 00210500

## SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Pipes, fittings, and specialties.
- 2. Sprinklers.

- B. SCOPE

- 1. Modify the existing wet automatic sprinkler system as required to suit the renovated space.

#### 1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

#### 1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. The design and installation of the automatic sprinkler systems and the alarm and supervisory systems shall be in strict accordance with all mandatory and recommended provisions of the NFPA, Industrial Risk Insurance (IRI), UL publications, and applicable building code. All recommended provisions of the

NFPA (National Fire Codes) listed below shall be considered as mandatory requirements.

2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
3. Sprinkler Occupancy Hazard Classifications:
  - a. Building Service Areas: Ordinary Hazard, Group 1.
  - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
  - c. General Storage Areas: Ordinary Hazard, Group 1.
  - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
  - e. Office and Public Areas: Light Hazard.
4. Minimum Density for Automatic-Sprinkler Piping Design:
  - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
  - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft area.
5. Maximum Protection Area per Sprinkler:
  - a. Office Spaces: 120 sq. ft..
  - b. Storage Areas: 130 sq. ft.
  - c. Mechanical Equipment Rooms: 130 sq. ft..
  - d. Electrical Equipment Rooms: 130 sq. ft..
  - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

## 1.6 SUBMITTALS

- A. Product Data: For the following:
  1. Piping materials, including sprinkler specialty fittings.
  2. Pipe hangers and supports .
  3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
  4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
  5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
  6. Alarm devices, including electrical data.
- B. Shop Drawings: Submit detailed working drawings in accordance with NFPA 13 for approval prior to fabrication of piping. Provide a layout and details sufficient to indicate the coordination of the location of sprinkler heads and piping with the ceiling

configuration and with the relocation of luminaries and interchangeability of ceiling components. Submit a statement from the sprinkler subcontractor certifying that the design meets the requirements of NFPA 13 and the hydraulic design parameters stated in this specification. Drawings shall be submitted and approved by local A.H.J. The drawings shall be on uniform size sheets equivalent to those used for the Contract Drawings. No work shall begin until the Architect/Engineer have approved the shop drawings.

- C. Hydraulic Calculations: Submit hydraulic calculations as part of the shop drawings. Field test reports and certificates. Prepare hydraulic calculations in accordance with NFPA 13 and the following:
  - 1. Minimum operating pressure of any sprinkler shall be according to NFPA 13 and UL listing/FM approval.
  - 2. Pipe friction losses may be calculated by using the nearest foot for all piping over one foot in lengths. Horizontal lengths less than one foot may be neglected. Vertical length less than foot shall be included for elevation purposes only.
  - 3. Flows shall be calculated to the nearest whole gallon.
  - 4. Velocity pressures may be neglected.
  - 5. Velocities in all piping shall not exceed 20 feet per second. Velocities in standpipes must be calculated based on the combined sprinkler flow and hose flow.
  - 6. Total sprinkler system flow shall not exceed 110 percent of the required flow.
  - 7. The sprinkler/standpipe risers shall accommodate both the sprinkler and standpipe hose stream flows. Each riser shall accommodate 250 gallons per minute flow for standpipe hose stream.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- E. Fire-hydrant flow test report.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- G. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. As specified in Division 1, Section 017700 "Closeout Procedures".
- B. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.
- C. As-Built Drawings: Upon completion of the work, the Contractor shall revise the original shop drawings to agree with the construction as actually accomplished. Prepare and submit 4 sets of the as-built drawings.
  - 1. The drawings shall include all information as required by NFPA 13.



2. The drawings shall also show the system as installed including all deviations from the approved shop drawings.
  3. The drawings shall be on uniform size sheets no smaller than the Contract Drawings (Minimum 30 inches by 42 inches).
  4. The drawings shall be prepared using AutoCAD 2000 or later. An electronic copy on CD shall be provided.
  5. Final testing shall be conducted after receipt of the as-built drawings.
- D. Submit four sets of final hydraulic calculations, manufacturer's data sheets, Authority Having Jurisdiction acceptance and NFPA certificates.

## 1.8 QUALITY ASSURANCE

### A. Installer Qualifications:

1. Company specializing in performing work for this project shall have a minimum of three years related experience, and shall have a sprinkler designer with a minimum NICET Level III certification to supervise completion of the design of this work.
2. Contractor shall be licensed to complete sprinkler installation by the State of Texas.
3. Contractor for the work under this section shall be a specialist in this field and have the personal experience, training, skill and the organization to furnish and install a practical working system. If required, the Contractor shall furnish acceptable evidence of having contracted for and installed not less than three systems of comparable size and type to this one, that have served their Owners satisfactorily for not less than three years.
4. Adequate and competent supervision shall be provided to ensure first class workmanship and installation. All field installation work shall be continuously supervised by a NICET Level II or III sprinkler system technician.
5. Contractor shall be responsible for all construction techniques required for all fire protection systems specified and shown on the drawings. Work shall be performed by mechanics skilled in the trade.
6. Contractor shall hold a Certificate of Registration from The State Fire Marshal per the Texas State Sprinkler Rules and Article 5.43-3 Insurance Code. Provide copy of license with bid.
7. Contractor shall be responsible for providing Responsible Managing Employee (R.M.E.) signature and R.M.E. number on shop drawings. Provide R.M.E. license and experience for review

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## 1.9 PROJECT CONDITIONS

### A. Damage:

1. Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.

### B. Leak Damage:

1. The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow. The Contractor shall pay for the necessary replacements or repairs to work of others damaged by such leakage.
2. Water shall not be introduced into the system during conditions where there is danger of freezing or when the building is not closed and heated.

## 1.10 COORDINATION

- ### A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

### B. Through-Penetration Firestop Systems Coordination:

1. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
2. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

## 1.11 EXTRA MATERIALS

- ### A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- ### A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

## 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized and Black Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method.
- B. Galvanized and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. National Fittings, Inc.
    - c. Shurjoint Piping Products.
    - d. Tyco Fire & Building Products LP.
    - e. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

## 2.4 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. CECA, LLC.
  - b. Corcoran Piping System Co.
  - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

## 2.5 SPRINKLERS

### A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

### B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

### C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

- D. Sprinkler Finishes:
1. Chrome plated.
  2. Bronze.
  3. Painted.
- E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
  2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- F. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  2. Standard: UL 199.
  3. Type: Wire cage with fastening device for attaching to sprinkler.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  1. Deviations from approved shop drawings for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install sprinkler piping with drains for complete system drainage.
- G. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- H. Fill sprinkler system piping with water.
- I. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "General Provisions for Fire-Suppression."
- K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "General Provisions for Fire-Suppression."

### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.4 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

### 3.5 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests as applicable.. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire-department equipment.

- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.7 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.8 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight, black-steel pipe with cut or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 3. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Concealed sprinklers, unless noted otherwise.
  - 3. Wall Mounting: Concealed sidewall sprinklers.
  - 4. All sprinkler heads installed within 7 feet of the floor or otherwise subject to mechanical damage shall be equipped with sprinkler guard.
  - 5. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.



- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted cover plate. Coordinate cover plate color with Architect.
  2. Concealed Sidewall Sprinklers: Rough brass, with factory-painted cover plate. Coordinate cover plate color with Architect.
  3. Upright and Pendent Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

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6/15/20

## SECTION 22 05 00 – GENERAL PROVISIONS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. General Provisions for Construction
  - 2. Piping materials and installation instructions common to most piping systems.
  - 3. Escutcheons.
  - 4. Equipment installation requirements common to equipment sections.
  - 5. Painting and finishing.
  - 6. Supports and anchorages.
  - 7. Close-out Documents and Requirements.

#### 1.3 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install," "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.
- B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. The use of the word "shall" conveys a mandatory condition to the contract.
- D. "This section" always refers to the section in which the statement occurs.
- E. "The project" includes all work in progress during the construction period.
- F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.
- G. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

- I. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- K. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- L. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- M. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 GENERAL:

- A. In general, the lines to be installed by the various trades under these specifications shall be run as indicated, as specified herein, as required by particular conditions at the site, and as required to conform to the generally accepted standards as to complete the work in a neat and satisfactorily workable manner. The following is a general outline concerning the running of various lines and is to be excepted where the drawings or conditions at the building necessitate deviating from these standards.
- B. All piping for the plumbing trade shall be concealed in chases in finished areas, except as indicated on the drawings. Horizontal lines run in areas that have ceilings shall be run concealed in those ceilings, unless otherwise specifically indicated or directed.
- C. Piping may be run exposed in machinery and equipment spaces, where serving as connections to equipment items in finished rooms where exposed connections are required, and elsewhere as indicated on the drawings or required.
- D. The Contractor shall thoroughly acquaint himself with the details of the construction and finishes before submitting his bid as no allowances will be made because of the Contractor's unfamiliarity with these details. Place all inserts in masonry walls while they are under construction. All concealed lines shall be installed as required by the pace of the general construction to precede that general construction.
- E. The plumbing plans do not give exact details as to elevations of lines, exact locations, etc., and do not show all the offsets, control lines, pilot lines and other installation details. The Contractor shall carefully lay out his work at the site to conform to the architectural and structural conditions, to provide proper grading of lines, to avoid all obstruction, to conform to details of installation supplied by the manufacturers of the

equipment to be installed, and thereby to provide an integrated, satisfactorily operating installation.

- F. The plumbing plans do not give exact locations of fixtures, valves, equipment items, etc. The exact location of each item shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with other sections. Minor relocations necessitated by the conditions at the site or as directed by the Architect shall be made without any additional cost accruing to the Owner.
- G. The Contractor shall be responsible for the proper fitting of his material and apparatus into the space. Should the particular equipment which any bidder proposes to install require other space conditions than those indicated on the drawings, he shall arrange for such space with the Architect before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make such necessary changes at his (the Contractor's) own expense.
- H. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans. The drawings shall be checked by the Architect before the work is started. Any conflict with the building conditions shall be corrected by the Contractor before the work proceeds.
- I. Order of precedence shall be observed in laying out the pipe, ductwork, material, and conduit in order to fit the material into the space above the ceiling and in the chases and walls. The following order shall govern:
  - 1. Items affecting the visual appearance of the inside of the building such as lighting fixtures, diffusers, grilles, outlets, panelboards, etc. Coordinate all items to avoid conflicts at the site.
  - 2. Lines requiring grade to function such as sewers.
  - 3. Large ducts and pipes with critical clearances.
  - 4. Conduit, water lines, and other lines whose routing is not critical and whose function would not be impaired by bends and offsets.
- J. Piping serving outlets on items of equipment shall be run in the most appropriate manner. Where the equipment has built-in chases, the lines shall be contained therein. Where the equipment is of the open type, the lines shall be run as close as possible to the underside of the top and in a neat and inconspicuous manner.
- K. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention before the contract is signed. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus, material, or equipment.
- L. The Contractor shall distinctly understand that the work described herein and shown on the accompanying drawings shall result in a finished and working job, and any item required to accomplish this intent shall be included whether specifically mentioned or not.
- M. Each bidder shall examine the plans and specifications for the General Construction. If these documents show any item requiring work under Division 22 and that work is not indicated on the respective "P" drawings, he shall notify the Architect in sufficient time

to clarify before bidding. If no notification is received, the Contractor is assumed to require no clarification, and shall install the work as indicated on the General Plans in accordance with the specifications.

1.5 DIMENSIONS:

- A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings. Any difference which may be found shall be submitted to the Architect for consideration before proceeding with the work.

1.6 INSPECTION OF SITE:

- A. The accompanying plans do not indicate completely the existing plumbing installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.7 SUBMITTALS

- A. Wherever shop drawings are called for in these specifications, they shall be furnished by the Contractor for the work involved after review by the Architect as to the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary details. Also, if the Contractor fails to comply with this provision, the Architect reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary and should there be any charges in connection with this, they shall be borne by the Contractor.
- B. Shop drawings will be reviewed by the Architect for general compliance with the design concept of the project and general compliance with the information given in the contract documents. Review by the Architect and any action by the Architect in marking shop drawings is subject to the requirements of the entire contract documents. Contractor will be held responsible for quantities, dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of all trades and the satisfactory performance of his work.
- C. Shop drawings submitted shall not consist of manufacturers' catalogues or tear sheets therefrom that contain no indication of the exact item offered. Rather, the submission

of individual items shall designate the exact item offered and shall clearly identify the item with the project.

- D. All shop drawings shall be submitted at one time and shall consist of a bound catalogue of all shop drawings under each section, properly indexed and certified that they have been checked by the Contractor.
- E. The omissions of any material from the shop drawings which has been shown on the contract drawings or specified, even though reviewed by the Architect, shall not relieve the Contractor from furnishing and erecting same.
- F. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
  - 5. Material indicated in other Division 22 Sections.

#### 1.8 QUALITY ASSURANCE

- A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.9 PERMITS, FEE, ETC.:

- A. The Contractor under each section of these specifications shall arrange for a permit from the local authority. The Contractor shall arrange for all utility services, including sewer, water and gas services as applicable. If any charges are made by any of the utility companies due to the work on this project, the Contractor shall pay these charges, including charges for metering, connection, street cutting, etc. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

#### 1.10 LAWS, CODES AND ORDINANCES:

- A. All work shall be executed in strict accordance with all local, state and national codes, ordinances and regulations governing the particular class of work involved, as interpreted by the inspecting authority. The Contractor shall be responsible for the final execution of the work under this heading to suit those requirements. Where these specifications and the accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect, shall prepare any supplemental drawings required illustrating how the work may be installed so as to comply and, on approval, make the changes at no cost to the Owner. On completion of the various portions of the work the installation shall be tested by the constituted authorities,

approved and, on completion of the work, the Contractor shall obtain and deliver to the Owner a final certificate of acceptance.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Refer to other Division 22 Sections for additional requirements.

#### 1.12 GUARANTEE:

- A. Unless a longer guarantee is hereinafter called for, all work, material and equipment items shall be guaranteed for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect, shall be repaired and/or replaced to the complete satisfaction of the Architect. Guarantee shall be in writing and in triplicate.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
    - a. Where a definite material is mentioned in these specifications, it has been done in order to establish a standard. The product of the particular manufacturer mentioned is of satisfactory construction and any substitution must be of quality as good as or better than the named article. No substitution shall be made without review by the Architect, who will be the sole judge of equality.
    - b. Should a substitution be accepted under the provisions of the conditions of these specifications, and should this substitute prove to be defective or otherwise unsatisfactory for the service for which it is intended within the guarantee period, the Contractor who originally requested the substitution shall replace the substitute material with the specified material.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.



## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

### PART 3 - EXECUTION

#### 3.1 RELOCATION OF EXISTING INSTALLATIONS:

- A. There are portions of the existing plumbing system which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations which must be relocated to avoid interferences with the installations of new work of his particular trade and that of all other trades. All such existing installations which interfere with new installations shall be relocated by the Contractor under the Division in which the existing material normally belongs, and in a manner as directed by the Architect.
- B. Failure to become familiar with the extent of the relocation work involved shall not relieve the Contractor of responsibility and shall not be used as a basis for additional compensation.

#### 3.2 ACCESS PANELS:

- A. Wherever plumbing equipment is installed and where future access is required through either walls or ceilings and such cannot be obtained through the removable ceiling or through other means, the Contractor shall provide Milcor Style "M" access doors at least 12 inches by 12 inches in size or larger if required for access. Provide access doors for all water hammer arrestors, valves, etc. Provide rated access panels as required for installation in rated construction.

#### 3.3 USE OF SYSTEMS:

- A. It is considered that it may be necessary to operate the plumbing systems during construction.
- B. Immediately prior to the time that the systems are to be accepted by the Owner, each system shall be carefully examined and cleaned. All filters shall be put in first class condition by replacement of filters and/or other procedures as directed.
- C. The use of the equipment shall in no way constitute acceptance of that equipment and the connected piping, insulation, finishes, etc. by the Owner. Furthermore, it shall in no way shorten the guarantee period hereinafter specified. The Contractor shall either secure extended warranties from the vendors of equipment or shall purchase insurance to provide proper coverage on the equipment through the guarantee period and shall file with the Architect substantiating affidavits from equipment manufacturers or a copy of the insurance policy covering the equipment through the guarantee period. The personal underwriting of the Contractor for equipment manufacturers' warranties is not acceptable, but his personal underwriting of piping, insulation and associated materials is acceptable subject to the provisions of the contract.
- D. The Contractor shall provide such labor as may be required in the operation of the systems and shall pay all costs.

3.4 OWNERS OCCUPANCY:

- A. It shall be understood that the building in which the work is to be done is a necessary part of the Owner's operation, and shall continue in use throughout the construction period without interruption. Take all precautions required by the Owner for the protection of his equipment and property.
- B. Contractor shall cooperate with the owner in scheduling areas in which work is permitted. Owners schedule will govern.

3.5 SCHEDULE OF WORK:

- A. The Contractor shall program his work in such manner as to interfere as little as possible with the normal routine of the Owner. It must be understood that the Owner will continue to function throughout the construction period. All water and sanitary facilities shall therefore be continued in operation with a minimum of interruption and the Contractor shall make any temporary connections necessary to comply with this requirement.
- B. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to insure meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates, schedule the times of work in the various areas involved, etc. Each Contractor shall cooperate in establishing these times and locations and shall process his work so as to insure the proper execution of it.
- C. Under no condition shall any work be done in the present building that would interfere with its natural use during its normal hours of occupancy, unless special permission is granted by the Owner. This is particularly applicable where new connections are to be made to present lines or items of equipment in that building or where present equipment items in that building are to be relocated or modified in any way. The Contractor shall include this scheduling requirement in his proposal as no additional compensation for overtime work will be granted.

3.6 WORKING TIME:

- A. Where new connections are to be made into existing lines, present lines must be relocated or rerouted, present equipment items relocated or other work accomplished that would affect the operation of the present building, the work shall be carried on at such times as to cause a minimum of interference with the normal operation of that building. In certain cases the work may be accomplished during normal working hours during certain designated seasons or times of the year. In other cases the work may have to be executed during times of the day outside of the normal working period, on holidays, etc. Each individual case presents a separate decision as to the time during which it shall be performed. The Contractor involved shall present each case to the Architect for his decision, which will be made after due consultation with the Owner. No additional compensation for overtime will be granted for compliance with these requirements.

### 3.7 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors, and within cabinets and millwork according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: one-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.

- h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.8 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.9 ELECTRICAL WIRING:

- A. All electric wiring of every character, except for temperature control, shall be done under Division 26 of these specifications. The Contractor for each section shall erect all his motors in place ready for connections. The Contractor, under Division 26, shall mount all the starters and controls, furnishing the supporting structures and any required outlet boxes.
- B. Every electrical current consuming device furnished as a part of this project, or furnished by the Owner and installed in this project, shall be completely wired up under Division 26. Verification of exact location, method of connection, number and size of wires required, voltage requirements, and phase requirements is the responsibility of the Contractor under Division 26. If conflicts occur between the drawings and the actual requirements, actual requirements shall govern.

3.10 SEALING AROUND PIPES:

- A. The Contractor installing pipes, shall seal all spaces between pipes and/or sleeves where they pierce walls, partitions or floors with Johns-Manville Firetemp CI intumescent caulk or as directed by architect. The packing shall effect a complete fire and/or air seal where pipes, pierce walls, floors or partitions.

3.11 PROGRESS OF WORK:

- A. The Contractor shall keep himself fully informed as to the progress of the work and do his work at the proper time without waiting for notification from the Architect or Owner.

3.12 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

3.13 MANUFACTURER'S DIRECTIONS:

- A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer.

3.14 MATERIALS AND WORKMANSHIP:

- A. All materials shall be new unless otherwise specified and of the quality specified. Materials shall be free from defects. All materials of a type for which the Underwriters

Laboratories, Inc. have established a standard shall be listed by the Underwriters Laboratories, Inc. and shall bear their label.

- B. Wherever the make of material or apparatus required is not definitely specified, the Contractor shall submit a sample to the Architect before proceeding.
- C. The Architect reserves the right to call for samples of any item of material offered in substitution, together with a sample of the specified material, when, in the Architect's opinion, the quality of the material and/or the appearance is involved and it is deemed that an evaluation of the two materials may be better made by visual inspection. This shall be limited to plumbing brass, grilles, registers, ceiling outlets and similar items and shall not be applicable to major manufacturers' items of equipment.
- D. The Contractor shall be responsible for transportation of his materials to and on the job, and shall be responsible for the storage and protection of these materials and work until the final acceptance of the job.
- E. The Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds, and all labor required for the safe and expeditious execution of his contract.
- F. The workmanship shall in all respects be of the highest grade and all construction shall be done according to the best practice of the trade.

### 3.15 PROTECTION OF APPARATUS:

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect his new apparatus from damage. This shall include the erection of all required temporary shelters to adequately protect any apparatus stored in the open on the site, the cribbing of any apparatus above the floor of the construction, and the covering of apparatus in the incompleting building with tarpaulines or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Architect will be sufficient cause for the rejection of the pieces of apparatus in question.

### 3.16 COOPERATION AND CLEANING UP:

- A. The contractor for the work under each section of these specifications shall coordinate his work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.
- B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

3.17 COORDINATION OF TRADES:

- A. The Contractor shall be responsible for resolving all coordination required between trades. For example, items furnished under Division 22 which require electrical connections shall be coordinated with Division 26 for:
  - 1. Voltage
  - 2. Phase
  - 3. Ampacity
  - 4. No. and size of wires
  - 5. Wiring diagrams
  - 6. Starter size, details and location
  - 7. Control devices and details
- B. Items furnished under various sections which require plumbing connections shall be coordinated for services, pressure, size and location of connections, type of fuel, clearances for service, auxiliary devices required, etc.
- C. Items requiring insulation shall be fully insulated and that insulation shall be checked against manufacturer's directions and job requirements for suitability, coverage, thickness and finish.
- D. Items installed in/on finished ceilings shall be coordinated with the ceiling construction. The Contractor under each section shall conform to the reflected ceiling plan and shall secure details and/or samples of the ceiling materials as necessary to insure compatibility. Any device not conforming to this requirement shall be replaced by the Contractor at his expense.
- E. All items specified under Division 22 shall be installed tight, plumb, level, square and symmetrically placed in relation to the work of other trades.
- F. Coordinate location and elevation of pipe with all other contractors such that required service areas shall not be encroached upon. Any piping found to be limiting service access to components installed by other contractors shall be removed and rerouted at no cost to the owner.

3.18 TESTING:

- A. The Contractor under each division shall at his own expense perform the various tests as specified and required by the Architect and as required by the State and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests. Notify the Architect a minimum of 24 hours in advance of all tests.

3.19 PAINTING

- A. All painting shall be done by the Contractor under Division 09. Following is a general outline of the required work for Division 22.
  - 1. When the factory finish on any apparatus or equipment is marred, it shall be touched up and then given one coat of half flat half enamel, followed by a coat of machinery enamel of a color to match the original. Paint factory primed surfaces.



2. Paint all exposed pipe, cabinets, hangers and supports and miscellaneous metal.
3. Paint all exposed sheet metal.
4. Paint all insulated surfaces exposed to view, including piping, equipment, etc. Size surfaces until a smooth, non grainy surface is obtained.
5. Generally, painting is required on all surfaces such that no exposed bare metal or insulation surface is visible.

### 3.20 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.21 INSTALLATION DRAWINGS:

- A. It shall be incumbent upon the Contractor to prepare special drawings as called for elsewhere herein or as directed by the Architect to coordinate the work under each section, to illustrate changes in his work, to facilitate its concealment in finished spaces to avoid obstructions or to illustrate the adaptability of any item of equipment which he proposes to use.
- B. These drawings shall be used in the field for the actual installation of the work. Unless otherwise directed, they shall not be submitted for approval but three copies shall be provided to the Architect for his information.

### 3.22 OPERATING INSTRUCTIONS:

- A. The Contractor for each section of the work hereunder shall, in cooperation with the representatives of the manufacturers of the various equipment items, carefully instruct the Owner's representatives in the proper operation of each item of equipment and of each system. During the balancing and adjusting of systems, the Owner's representative shall be made familiar with all procedures.
- B. The contractor shall coordinate the date and time for the training with the Owner's representative and shall document attendance with a sign-in sheet. At a minimum, the sign-in sheet shall indicate the date and location of the session, name and organization of each participant, and a list of any material that may be provided. This information shall be provided to the Architect as part of the closeout documents. Failure to provide documentation of training may require the contractor to provide a subsequent training session.

3.23 OPERATING MANUALS:

- A. Prepare and submit 3 copies of the operating manuals bound in hard covers. Three weeks prior to completion of the work, the Architect will check the manuals and any additional material necessary to complete the manuals shall be furnished and inserted by the Contractor.
- B. Manuals shall contain the following data:
  - 1. Catalogue data of all equipment.
  - 2. Shop drawings of all equipment.
  - 3. Start-up instructions for major equipment.
  - 4. Trouble shooting procedures for major equipment.
  - 5. Wiring diagrams.
  - 6. Recommended maintenance schedule for equipment.
  - 7. Parts list for all items.
  - 8. Name and address of each vendor.

3.24 COMPLETION REQUIREMENTS:

- A. Before acceptance and final payment the Contractor under each Division of the specifications shall furnish:
  - 1. Accurate record drawings, shown in red ink on blue line prints furnished for that purpose all changes from the original plans made during installation of the work. Drawings shall be filed with the Architect when the work is completed.
  - 2. All manufacturers' guarantees.
  - 3. All operating manuals.
  - 4. Guarantees.

3.25 CONTRACTOR'S RESPONSIBILITY FOR FINAL INSPECTION:

- 1. Before calling for the final inspection, the Contractor under each Division shall carefully inspect his work to be sure it is complete and according to plans and specifications.

END OF SECTION 22 05 00

## SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Bronze ball valves.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball and plug valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 4 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

### 2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corporation.
  
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Three piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

### 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Ball Valves: Two piece, full port, bronze with bronze trim.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe positioning systems.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

## 1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

#### A. Carbon-Steel Pipe Hangers and Supports:

- 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
- 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
- 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
- 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

#### B. Stainless-Steel Pipe Hangers and Supports:

- 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
- 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
- 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

#### C. Copper Pipe Hangers:

- 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
- 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### 2.2 METAL FRAMING SYSTEMS

#### A. MFMA Manufacturer Metal Framing Systems:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Allied Tube & Conduit.
  - b. Cooper B-Line, Inc.
  - c. Flex-Strut Inc.
  - d. GS Metals Corp.
  - e. Thomas & Betts Corporation.
  - f. Unistrut Corporation; Tyco International, Ltd.



## g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Hot-dipped galvanized.

## 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carpenter & Paterson, Inc.
  2. ERICO International Corporation.
  3. National Pipe Hanger Corporation.
  4. PHS Industries, Inc.
  5. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  6. Rilco Manufacturing Co., Inc.
  7. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts

before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.3 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.4 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

## SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe labels.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. Color scheme shall comply with ANSI A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.



1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.2 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings.

END OF SECTION 22 05 53

## SECTION 22 07 19 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## 1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Ramco Insulation, Inc.; Super-Stik.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
- b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
- b. Eagle Bridges - Marathon Industries; 570.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
  - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
  - c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

## 2.6 SEALANTS

### A. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.7 FACTORY-APPLIED JACKETS

- ### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.8 TAPES

- ### A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ABI, Ideal Tape Division; 428 AWF ASJ.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
  - c. Compac Corporation; 104 and 105.
  - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.

## 2.9 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ITW Insulation Systems; Gerrard Strapping and Seals.
    - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.



- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.

4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

### 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.7 FIELD QUALITY CONTROL

- A. The installation of all thermal insulation shall be performed by a recognized firm regularly engaged in the insulation business, using skilled insulation mechanics and using insulation materials which are the product of reputable manufacturer of the materials, using any special materials as required by these specifications and by those published standards.
- B. Any insulation which is not applied in a workmanlike manner will be rejected and replaced. All coverings shall be smooth, flush, dressed to line and tight. Mastic shall be neatly applied and tooled. The Architect reserves the right to reject any insulation whose appearance he deems unacceptable.

### 3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
  2. Domestic cold water valves and unions.

### 3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  1. Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  1. Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 22 07 19

## SECTION 22 11 16 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data for all items within.

#### 1.4 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Refer to 22 05 00 General Provisions for Plumbing.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

#### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- E. Copper Pressure-Seal-Joint Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Elkhart Products Corporation.
    - b. NIBCO Inc.
    - c. Viega.
  - 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  - 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

## 2.3 PIPING JOINING MATERIALS

- A. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys.
- C. Flux: ASTM B 813, water flushable.

## 2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Central Plastics Company.
    - c. Watts; a division of Watts Water Technologies, Inc.

- d. Wilkins; a Zurn company.
  2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 150 psig or 300 psig.
  5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig or 300 psig..
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products; Tyco Fire Products LP.
    - c. Precision Plumbing Products, Inc.
    - d. Victaulic Company.
  2. Standard: IAPMO PS 66.
  3. Electroplated steel nipple complying with ASTM F 1545.
  4. Pressure Rating and Temperature: 300 psig at 225 deg F.
  5. End Connections: Male threaded or grooved.
  6. Lining: Inert and noncorrosive, propylene.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Refer to Section 22 05 00 General Provisions for Plumbing.

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.



- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits or nipples.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 ADJUSTING

A. Perform the following adjustments before operation:

1. Open shutoff valves to fully open position.
2. Open throttling valves to proper setting.
3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
4. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
  - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.10 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

END OF SECTION 22 11 16

## SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Water-hammer arresters.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14 for plastic components..

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

## 2.3 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Precision Plumbing Products, Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products.
  - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install water-hammer arresters in water piping according to PDI-WH 201.

END OF SECTION 22 11 19

## SECTION 22 61 13 - COMPRESSED-AIR PIPING FOR LABORATORY FACILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 150 psig or less.
- B. Related Sections include the following:
  - 1. Division 11 for sinks, plumbing trim and gas outlets in/on laboratory equipment.

#### 1.3 DEFINITIONS

- A. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Piping and fittings.
  - 2. Dielectric fittings.

#### 1.5 QUALITY ASSURANCE

- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- B. ASME Compliance:
  - 1. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

#### 1.6 COORDINATION

- A. Coordinate route of pipe with new and existing ducts, lights, conduits, and pipe. Offset pipe as required.
- B. Coordinate air connections with laboratory equipment.

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K seamless, drawn-temper, water tube.
  - 1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
  - 2. Copper Unions: ASME B16.22 or MSS SP-123.

### 2.2 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

### 2.3 DIELECTRIC FITTINGS

- A. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include end connections that match piping system materials.
- B. Dielectric Unions: Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a) EPCO Sales, Inc.
    - b) Watts Water Technologies, Inc.; Water Products Div.
    - c) Zurn Plumbing Products Group; Wilkins Div.

### 2.4 ESCUTCHEONS

- A. General Requirements: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
- B. One-Piece, Cast-Brass Escutcheons: With set screw.
  - 1. Finish: Polished chrome-plated.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Install piping as indicated unless deviations to layout are approved.



- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- I. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- J. Install piping to permit valve servicing.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.

### 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- D. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

### 3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

### 3.4 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

### 3.6 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment"

### 3.7 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.
- B. Tests and Inspections:
  - 1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 150% of system operating pressure, but not less than 125 psig. Isolate test source and let stand for two hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
  - 2. Repair leaks and retest until no leaks exist.
  - 3. Inspect filters and pressure regulators for proper operation.

END OF SECTION 22 61 13

## SECTION 22 62 13 - VACUUM PIPING FOR LABORATORY FACILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Laboratory piping and specialties
- B. Related Sections include the following:
  - 1. Division 11 Section "Laboratory Fume Hoods" for vacuum outlets in laboratory fume hoods.
  - 2. Division 12 Section "Laboratory Casework" for vacuum outlets in metal casework.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Vacuum pipe and fittings.

#### 1.4 QUALITY ASSURANCE

- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- B. Comply with ASME B31.9, "Building Services Piping," for vacuum piping in laboratory facilities.

#### 1.5 COORDINATION

- A. Coordinate route of pipe with new and existing ducts, lights, conduits, and pipe. Offset pipe as required.
- B. Coordinate vacuum connections with laboratory equipment.

### PART 2 - PRODUCTS

#### 2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Water Tube: ASTM B 88, Type L (ASTM B 88M, Type C), seamless, drawn temper.
  - 1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.

2. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.

## 2.2 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- B. Threaded-Joint Tape: PTFE.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Nonhealthcare Laboratory Low Vacuum Piping: Use the following piping materials:
  1. Type L, copper tube; wrought-copper fittings; and brazed joints.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Install piping as indicated unless deviations to layout are approved.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and specialties to allow service and maintenance.
- F. Install vacuum piping with 1 percent slope downward in direction of flow.
- G. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications below unless otherwise indicated.
- H. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- I. Install piping to permit valve servicing.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and for branch connections

- L. Install unions, in copper vacuum tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

### 3.5 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment".

### 3.6 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.
- B. Tests and Inspections:
  - 1. Piping Leak Test: Test new and modified parts of existing piping. Cap and fill vacuum piping with gaseous nitrogen to pressure to not less than 60 psig. Isolate the test source and let stand for two hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
  - 2. Repair leaks and retest until no leaks exist.

END OF SECTION 22 62 13

## **SECTION 22 63 13 - GAS PIPING FOR LABORATORY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Furnish and install laboratory gas piping, fittings, valves, and equipment as indicated herein. This includes all required hardware and associated items for a complete code compliant operational system.
- B. Included in this section are pipe, fittings, and valves.
- C. Rough-in and make final connection of laboratory gas piping to lab gas outlets, as indicated on the drawings and specifications.
- D. Contractor is responsible for providing all specified and code required test reports.
- E. Related Sections include the following:
  - 1. List below only products that the reader might expect to find in this Section but are specified elsewhere.
  - 2. Division 11 Section "Laboratory Fume Hoods" for gas outlets in laboratory fume hoods.
  - 3. Division 12 Section "Laboratory Casework" for gas outlets in casework.
  - 4. Division 22 Section "Compressed-Air Piping for Laboratory" for compressed-air piping systems for laboratory.
  - 5. Division 22 Section "Vacuum Piping for Laboratory" for vacuum piping systems for laboratory.

#### **1.3 DEFINITIONS**

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. Specialty Gas: Gas, other than medical gas, for nonmedical laboratory facility applications.

#### **1.4 SUBMITTALS**

- A. Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
- B. Brazing certificates.
- C. Field quality-control test reports.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. The equipment manufacturer shall have 24-hour local service available provided by a trained factory authorized representative.
- B. Installer's Qualifications: The equipment shall be installed by a firm having minimum three years of experience regularly engaged and certified in the installation of equipment being supplied.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- D. Maintain one copy of each document on site.

## 1.6 SECTION INCLUDES

- A. Nitrogen Gas System

## 1.7 PRODUCTS NOT FURNISHED UNDER THIS SECTION

- A. Owner furnished high pressure laboratory gas cylinders.

## 1.8 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 00.
- B. Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
- C. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.

## 1.9 QUALIFICATIONS

- A. The manufacturer of system components shall be regularly engaged in the design, testing and manufacturing of specified products and issuing complete data for such products.
- B. The manufacturer shall provide written certification that the products provided meet or exceed the specification requirements.
- C. The Contractor shall specialize in performing the work of this Section with minimum three years documented experience. All installations of the piping systems shall be done only by, or under the direct supervision of a holder of a master plumber license or a journeyman plumber license. All installers of piping system components must be qualified in accordance with the requirements of NFPA 99 and ASSE 6010, Medical

Gas Systems Installers Professional Qualifications Standard. In addition, all brazers of laboratory gas system piping must be qualified in accordance with the requirements of either Section IX, Welding and Brazing Requirements of the ASME Boiler and Pressure Vessel Code, or AWS B2.2, Standard for Brazing Procedure and Performance Qualification.

- D. A third party testing agency is not required. However, the system testing shall be conducted by an individual technically competent and experienced in the field of laboratory gas systems testing and meeting the requirements of ANSI/ASSE Standard 6030, Medical Gas Verifiers Professional Qualifications Standard. Quality control standards of testing agency shall be in strict accordance with American National Standards Institute (ANSI) Q-91. All testing shall be documented in writing.

#### 1.10 REGULATORY REQUIREMENTS

- A. Conform with applicable codes for laboratory gas systems.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, store, protect and handle products to site under provisions of Section 22 00 00.
- B. Tubing, valves, fittings, station outlets, and other piping components in laboratory gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation in accordance with CGA 4.1, Cleaning Equipment for Oxygen Service, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer.
- C. Each length of tube/pipe shall be stenciled from the factory indicating the manufacturer's trademark, size, type, and ASTM number. Marking shall be continuous for full length of each piece of tube/pipe.
- D. Each length of tube shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.
- E. Fittings, valves, and other components shall be delivered sealed, labeled, and kept sealed until installation.
- F. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.
- G. Where contamination is known to have occurred, the materials affected must be removed and replaced with new materials that are cleaned and sealed by the manufacturer or supplier.

#### 1.12 COORDINATION

- A. Coordinate route of pipe with new and existing ducts, lights, conduits, and pipe. Offset pipe as required.



## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

#### A. Copper Piping Systems:

1. Provide Type K hard drawn seamless copper tubing conforming to ASTM B280 and ASTM B819, factory cleaned, sealed, and marked for oxygen service NFPA 99 compliant with wrought copper socket fittings complying with ANSI B16.19, B16.22, and ASTM G-93. All joints shall be brazed, except where threaded or flanged connections are required at equipment. All piping shall be purged with dry nitrogen while being brazed. Cast copper alloy fittings shall not be permitted. Where threaded nipples are required at equipment connections, these shall be I.P.S. brass.
2. All joining operations shall be performed with pure dry nitrogen flowing through the pipe to prevent oxidation and scale information. During joining operations, nitrogen flow shall be verified by an oxygen sensor at the free end of the piping and by a pressure alarm on the nitrogen supply. When there are no active joining operations being performed, the system shall be securely capped and maintained with a nitrogen charge in the capped system. Taping the ends of the piping systems with a nitrogen purge is not acceptable, the ends must be capped. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538° F. Copper-to-copper joints shall be brazed using a copper-phosphorus or copper-phosphorus-silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg sense) brazing filler metal. Brazing alloy shall comply with ANSI/AWS A5.8
3. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted.
4. Where threaded connections are required at equipment, suitable adapters shall be provided with threaded connections. A thin paste of litharge and glycerin shall be applied to the external threads only.
5. Threaded joints shall be limited to connection to equipment and system outlets. Pipe threads shall conform to ANSI B1.20.1. Threaded joints shall be made up Teflon tape or other thread sealant recommended for oxygen service.
6. Pro-press type joints, rolled grooved type joints and t-drill type connections are not allowed.

### 2.2 VALVES

#### A. Copper Piping Systems:

1. General: All valves shall be factory supplied cleaned and sealed (bagged) for oxygen service, NFPA 99 compliant. Valves shall have type "K" washed and degreased copper pipe stub extensions at both the inlet and outlet sides of the valve port. On outlet pipe stub provide 1/8" FPT tap with plug to accept gauge or nitrogen purge connection. Stub extensions shall be factory supplied capped at both ends. Manufactured by Milwaukee, Nibco, Beacon Medaes, Ohio Medical or Amico.
2. Ball valves:

- a. Ball valves shall be full port, double seal, ball-type three-piece design, quarter turn, designed for vacuum to 29 inches Hg and working pressures up to 600 WOG with bronze/brass body, blow-out proof stem, stainless steel ball, trim, and stem, and be serviceable in the line.
  - b. Valve body shall have Teflon (TFE) material ball seat and stem seals. Seats/seals, lubricants and valve material shall be compatible with the laboratory gas piping systems specified herein, at a continuous pressure up to 600 psig and up to 100 degrees Fahrenheit.
3. Check Valves: Check valves shall be spring loaded ball type three-piece design with inline removable brass body, Teflon seat, rated for 300 psig minimum working pressure, test ports on both ends, with Type "K" copper tube extensions.
  4. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.
- B. Pressure Regulators: Bronze body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure-setting adjustment; rated for 250-psig (1725-kPa) minimum inlet pressure; and capable of controlling delivered gas pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

### 2.3 PIPELINE GAUGES

- A. Bourdon tube type, with stainless steel spring, suspended movement, 316 stainless steel bourdon tube, with a minimum 2-1/2" dial, shatterproof glass window with stainless steel case, 1/4" NPT [brass][stainless steel] socket connection, 1% full scale accuracy and manufactured in accordance with ASME 40.1 Grade 1A, scale range 0-160 psig, figure intervals at 20 psi, and minor divisions at 2 psi increments, manufactured by Terrice No. 700 Series, or approved equal by Ashcroft or Weksler.

### 2.4 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.

- G. One-Piece, Floor-Plate Escutcheons: Cast iron.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## 2.5 NITROGEN

- A. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Specialty Gas Piping NPS 2-1/2 and Smaller: Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Install piping as indicated unless deviations to layout are approved.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and specialties to allow service and maintenance.
- F. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
- G. Install piping to permit valve servicing.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Branch takeoffs from horizontal piping shall be taken off above the centerline of the main or branch pipe and rise vertically or at an angle of not less than 45 degrees from vertical.

- K. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
- L. Install unions, in copper tubing adjacent to each valve and at final connection to each piece of equipment and specialty.
- M. Laboratory gas piping systems shall not be used as a grounding electrode.

### 3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
- B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
- C. Install pressure regulators on gas piping where reduced pressure is required.

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.
- D. Brazed Joints:
  - 1. The exterior surface of all tubes, joints and fittings shall be cleaned prior to brazing with non-abrasive pads by washing with hot water and after assembly to remove any surface oxides or excess flux and provide for clear visual inspection of brazed connections. A visual inspection of each brazed joint shall be made to assure that the alloy has flowed completely around the joint at the tube-fitting interface. Where flux has been used, assure that solidified flux residue has not formed a temporary seal that could hold test pressure.
  - 2. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside of completed joints. (NOTE: Ensure proper ventilation. Some BAg series filler metals contain cadmium, which, when heated during brazing, can produce toxic fumes.)
  - 3. Joints shall be brazed within one hour after the surfaces are cleaned for brazing.
  - 4. While being brazed, all piping joints shall be continuously purged with oil-free, dry Nitrogen to prevent the formation of copper oxide on the inside surfaces of the joint. The purge shall be maintained until the joint is cool to the touch. The final connection of new piping to an existing, in-use pipeline shall be permitted to be made without the use of a nitrogen purge.

### 3.5 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
    - b. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
    - c. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
  - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1/4: 60 inches with 3/8-inch rod.
  - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
  - 3. NPS 3/4: 84 inches with 3/8-inch rod.
  - 4. NPS 1: 96 inches with 3/8-inch rod.
  - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
  - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
  - 7. NPS 2: 11 feet with 3/8-inch rod.
- I. Install supports for vertical copper tubing every 10 feet (3 m).

### 3.7 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
  - 1. Nitrogen: White letters on black background.

### 3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

- A. Perform field tests and inspections of specialty gas piping for nonhealthcare laboratory facilities and prepare test reports.
- B. Tests and Inspections:
  - 1. Inspection and testing shall be performed on all new piped gas systems, additions, renovations, temporary installations, or repaired systems, to assure the facility, by a documented procedure, that all applicable code provisions have been adhered to and system integrity has been achieved or maintained.
  - 2. Before erection, all pipe, tubing, valves and fittings (except those supplied expressly cleaned for service by manufacturer as specified herein) shall be thoroughly cleansed of all grease, oil and other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in equal proportions of one pound to three gallons of water. Scrubbing and continuous agitation of the parts shall be employed where necessary to remove all deposits and to insure complete cleansing. After washing, all materials shall be rinsed thoroughly in clean, hot water. After rinsing, great care must be exercised in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease being introduced into the tubing. Where such contamination is known to have occurred, the materials affected must be rewashed and then rinsed.
  - 3. After joining of the piping system, the outside of all joints shall be cleaned by washing with water and a wire brush to remove any residue and permit clear visual inspection of the joint. Each pipe joint shall be visually inspected after cleaning the outside surfaces. Pipe joints identified as defective shall be repaired or replaced.
  - 4. Repair leaks and retest until no leaks exist.
  - 5. Inspect specialty gas regulators for proper operation.
- C. Purging and Pressure Testing:
  - 1. Copper Piping Systems:
    - a. After installation of the distribution piping and before installation of station outlets/inlets and other system components the piping distribution systems shall be blown clear by means of oil-free dry nitrogen.
    - b. All copper piping gas systems shall be finally cleaned using the high-pressure pulse-purge procedure described in NFPA 99. During this

procedure, sufficient volume of dry nitrogen shall be provided to insure a minimum velocity of 2000 fpm in the largest section of pipe being cleaned. Note: It is not required that the entire system be tested at one time. The system can be divided into convenient sections. Upon the successful completion of the operation on a section, it shall be sealed (capped) and left with a holding charge of dry nitrogen.

- c. After installing service outlet valves, each system shall be subjected to a test pressure of 150 psig by means of waterpumped (oil free) nitrogen or air. This test pressure shall be maintained until each joint has been thoroughly examined for leaks by means of soapy water. A soap solution mixed in the following proportions should be used: one ounce of Castile or palm oil soap, eight ounces of water, and four ounces of glycerin. Dissolve the soap in the water, add the glycerin and mix thoroughly. Wipe joints clean after test. All leaks shall be properly repaired and the system retested.
- d. A final test shall be 24 hours standing pressure test with water pumped (oil free) air or dry nitrogen at 150 psig to check the completeness of prior joint pressure tests. If water pumped nitrogen is used, particular care must be exercised to assure that it is all flushed out with oxygen before placing the system in service.
- e. Installer shall perform initial pressure tests, cross-connection test, piping purge test and standing pressure test prior to final system verification and in accordance with NFPA 99.
- f. The rated accuracy of indicators used for testing shall be 1 percent (full scale) or better at the point of reading.
- g. System verification tests shall be performed only after all installer performed tests, have been completed. Equipment Vendor or installing Contractor shall not perform system verification, final testing or certification.

END OF SECTION 22 63 13

## SECTION 22 66 00 - CHEMICAL-WASTE PIPING

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following components for chemical-waste and vent piping:
  - 1. Single-wall piping.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow Drainage Piping:
  - 1. Single-Wall Piping Pressure Rating: 10 feet head of water (30 kPa).

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain pipe, fittings, and joining materials for each piping system through one source from a single manufacturer.
- B. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
- C. NFPA Compliance: Comply with NFPA 70, "National Electrical Code."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, fittings, and seals from dirt and damage.



## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL PIPE AND FITTINGS

- A. Piping in return air plenum: ASTM E-84, Plenum rated, acid resistant PVDF (Polyvinylidene fluoride) pipe joined with fusion lock joining system.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. IPEX Inc.
    - b. Orion Fittings, Inc.
    - c. Sloane, R & G Manufacturing Co., Inc.
    - d. Town & Country Plastics, Inc.
    - e. Watts Industries (Canada) Inc.
    - f. Zurn Plumbing Products Group; Chemical Drainage Systems.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
- B. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

### 3.2 JOINT CONSTRUCTION

- A. Follow piping manufacturer's written instructions.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Pipe sizes in this Article refer to aboveground, single-wall piping.
- B. Refer to Division 22 05 29 for pipe hanger and support devices. Install the following:
- C. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of **3/8 inch**.

### 3.4 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in 22 05 53.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

### 3.6 CLEANING

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with potable water.

END OF SECTION 22 66 00

## SECTION 22 67 00 - PROCESSED WATER SYSTEMS FOR LABORATORY FACILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes reverse-osmosis-water piping.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings:
  - 1. Deionized-Water Piping: 150 psig unless otherwise indicated.
  - 2. Reverse-Osmosis-Water Piping: 150 psig unless otherwise indicated.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.3, "Process Piping," for piping conveying fluid at a pressure of 15 psig or greater.

### PART 2 - PRODUCTS

#### 2.1 PLASTIC PIPE AND FITTINGS

- A. PVDF Pipe and Fittings: Made from ASTM D 3222, PVDF resin.
  - 1. Schedule 40, Pipe and Fittings: Pipe made to ASTM D 2447, Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.

## 2.2 TRANSITION FITTINGS

- A. Transition Fittings: Couplings, flanges, or other manufactured fittings; same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

## 2.3 PVDF VALVES

- A. PVDF Ball Valves:
  - 1. Description:
    - a. Standard: MSS SP-122.
    - b. Pressure Rating: 150 psig at 73 deg F.
    - c. Body Material: ASTM D 3222, PVDF resin.
    - d. Body Design: Union type.
    - e. End Connections: Detachable, butt or socket.
    - f. Ball: ASTM D 3222, PVDF resin.
    - g. Port: Full.
    - h. Seats: PTFE.
    - i. Stem: ASTM D 3222, PVDF resin.
    - j. Stem Seals: FKM-rubber O-rings.
    - k. Handle: Tee shaped.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for removal of ceiling panel, and coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Install piping to permit valve servicing.

- G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.2 JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. PVDF Piping Heat-Fusion Joints: Make according to ASTM D 2657.
- C. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

### 3.3 VALVE INSTALLATION

- A. Install sectional valves close to mains on each branch and riser serving equipment.
- B. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
- E. Install plastic valves of the same material as the plastic pipe in which they are installed.
- F. Install valves in horizontal piping with stem at or above center of pipe.
- G. Install valves in position to allow full movement of stem and lever handle.
- H. Install ball-check valves in horizontal or vertical position so ball will unseat during normal flow.

- I. Install swing-check valves in horizontal position with the hinge pin level.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  3. Clamps for Vertical Piping: MSS Type 8 or Type 42.
  4. Individual, Straight, Horizontal Piping Runs:
    - a. **100 Feet** and Less: MSS Type 1, adjustable clevis hangers.
    - b. Longer Than **100 Feet**: MSS Type 43, adjustable roller hangers.
    - c. Longer Than **100 Feet** if Indicated: MSS Type 49, spring cushion rolls.
  5. Multiple, Straight, Horizontal Piping Runs, **100 Feet** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within **12 inches** of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to minimum **3/8 inch**.
- E. Install padded hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:
  1. **NPS 1** and Smaller: **30 inches** with **3/8-inch** rod.
  2. **NPS 1-1/4**: **33 inches** with **3/8-inch** rod.
  3. **NPS 1-1/2 and NPS 2**: **36 inches** with **3/8-inch** rod.
  4. **NPS 2-1/2 and NPS 3**: **48 inches** with **1/2-inch** rod.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

- C. Connect reverse-osmosis-water piping to equipment and service outlets with unions or flanges.

### 3.6 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.7 FIELD QUALITY CONTROL

- A. Test new piping, and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.
  - 1. Schedule tests and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
  - 2. Do not cover piping or put into service before inspection and approval.
  - 3. Test completed piping according to authorities having jurisdiction. If authorities having jurisdiction does not have published procedures, perform tests as follows:
    - a. Hydrostatic Tests: Test piping at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than **100 psig**.
      - 1) Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.
  - 4. Replace leaking joints with new materials and retest until no leaks exist.
  - 5. Submit separate reports for each test.

### 3.8 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
  - 1. Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.
  - 2. Clean piping by flushing with reverse-osmosis water.

### 3.9 PIPING SCHEDULE

- A. This Section includes piping, valves, and other components for processed-water systems **NPS 3** or smaller.
- B. Transition and special fittings with pressure ratings at least equal to piping, and of same or compatible material, may be used in applications below.
- C. Reverse-Osmosis-Water Piping: Use the following piping materials for each pipe size range:

1. **NPS 3** and Smaller: PVDF pipe and fittings and heat-fusion joints.

### 3.10 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Install ball valves in piping **NPS 2** and smaller. Install butterfly or diaphragm valves for **NPS 3** piping.
  2. Throttling Duty: Install ball valves in piping **NPS 2** and smaller. Install diaphragm valves for **NPS 3** piping.

END OF SECTION 22 67 00



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6/15/20

## SECTION 23 05 00 – GENERAL PROVISIONS FOR MECHANICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 CHECKING DOCUMENTS:

- A. The drawings and the specifications are numbered consecutively. The Contractor shall check the drawings and specifications thoroughly and shall notify the Architect of any discrepancies or omissions of sheets or pages. Upon notification, the Architect will promptly provide the Contractor with any missing portions of the drawings or specifications. No discrepancies or omissions of sheets or pages of the contract documents will relieve the Contractor of his duty to provide all work required by the complete contract documents.

#### 1.3 SUMMARY

- A. This Section includes the following:
  - 1. General Provisions for Construction
  - 2. Equipment installation requirements common to equipment sections.
  - 3. Painting and finishing.
  - 4. Supports and anchorages.
  - 5. Close-out Documents and Requirements

#### 1.4 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install," "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.
- B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. The use of the word "shall" conveys a mandatory condition to the contract.
- D. "This section" always refers to the section in which the statement occurs.
- E. "The project" includes all work in progress during the construction period.

- F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.
- G. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- I. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- K. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

#### 1.5 GENERAL:

- A. In general, the lines and ducts to be installed by the various trades under these specifications shall be run as indicated, as specified herein, as required by particular conditions at the site, and as required to conform to the generally accepted standards as to complete the work in a neat and satisfactorily workable manner. The following is a general outline concerning the running of various lines and ducts and is to be excepted where the drawings or conditions at the building necessitate deviating from these standards.
- B. All piping and ductwork for the mechanical trade shall be concealed in chases in finished areas, except as indicated on the drawings. Horizontal lines run in areas that have ceilings shall be run concealed in those ceilings, unless otherwise specifically indicated or directed.
- C. Piping and ductwork may be run exposed in machinery and equipment spaces, where serving as connections to equipment items in finished rooms where exposed connections are required, and elsewhere as indicated on the drawings or required.
- D. The Contractor shall thoroughly acquaint himself with the details of the construction and finishes before submitting his bid as no allowances will be made because of the Contractor's unfamiliarity with these details. Place all inserts in masonry walls while they are under construction. All concealed lines shall be installed as required by the pace of the general construction to precede that general construction.
- E. The mechanical plans do not give exact details as to elevations of lines and ducts, exact locations, etc., and do not show all the offsets, control lines, pilot lines and other installation details. The Contractor shall carefully lay out his work at the site to conform to the architectural and structural conditions, to provide proper grading of lines, to avoid all obstruction, to conform to details of installation supplied by the manufacturers of the

equipment to be installed, and thereby to provide an integrated, satisfactorily operating installation.

- F. The mechanical plans do not give exact locations of outlets, fixtures, equipment items, etc. The exact location of each item shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with other sections. Minor relocations necessitated by the conditions at the site or as directed by the Architect shall be made without any additional cost accruing to the Owner.
- G. The Contractor shall be responsible for the proper fitting of his material and apparatus into the space. Should the particular equipment which any bidder proposes to install require other space conditions than those indicated on the drawings, he shall arrange for such space with the Architect before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make such necessary changes at his (the Contractor's) own expense.
- H. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans. The drawings shall be checked by the Architect before the work is started. Any conflict with the building conditions shall be corrected by the Contractor before the work proceeds.
- I. Order of precedence shall be observed in laying out the pipe, ductwork, material, and conduit in order to fit the material into the space above the ceiling and in the chases and walls. The following order shall govern:
  - 1. Items affecting the visual appearance of the inside of the building such as lighting fixtures, diffusers, grilles, outlets, panelboards, etc. Coordinate all items to avoid conflicts at the site.
  - 2. Lines requiring grade to function such as sewers.
  - 3. Large ducts and pipes with critical clearances.
  - 4. Conduit, water lines, and other lines whose routing is not critical and whose function would not be impaired by bends and offsets.
- J. Piping and ducts serving outlets on items of equipment shall be run in the most appropriate manner. Where the equipment has built-in chases, the lines shall be contained therein. Where the equipment is of the open type, the lines shall be run as close as possible to the underside of the top and in a neat and inconspicuous manner.
- K. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention before the contract is signed. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus, material, or equipment.
- L. The Contractor shall distinctly understand that the work described herein and shown on the accompanying drawings shall result in a finished and working job, and any item required to accomplish this intent shall be included whether specifically mentioned or not.
- M. Each bidder shall examine the plans and specifications for the General Construction. If these documents show any item requiring work under Division 23 and that work is not indicated on the respective "M" drawings, he shall notify the Architect in sufficient time

to clarify before bidding. If no notification is received, the Contractor is assumed to require no clarification, and shall install the work as indicated on the General Plans in accordance with the specifications.

1.6 DIMENSIONS:

- A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings. Any difference which may be found shall be submitted to the Architect for consideration before proceeding with the work.

1.7 INSPECTION OF SITE:

- A. The accompanying plans do not indicate completely the existing mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.8 SUBMITTALS

- A. Wherever shop drawings are called for in these specifications, they shall be furnished by the Contractor for the work involved after review by the Architect as to the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary details. Also, if the Contractor fails to comply with this provision, the Architect reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary and should there be any charges in connection with this, they shall be borne by the Contractor.
- B. Shop drawings will be reviewed by the Architect for general compliance with the design concept of the project and general compliance with the information given in the contract documents. Review by the Architect and any action by the Architect in marking shop drawings is subject to the requirements of the entire contract documents. Contractor will be held responsible for quantities, dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of all trades and the satisfactory performance of his work.
- C. Shop drawings submitted shall not consist of manufacturers' catalogues or tear sheets therefrom that contain no indication of the exact item offered. Rather, the submission

of individual items shall designate the exact item offered and shall clearly identify the item with the project.

- D. All shop drawings shall be submitted at one time and shall consist of a bound catalogue of all shop drawings under each section, properly indexed and certified that they have been checked by the Contractor.
- E. The omissions of any material from the shop drawings which has been shown on the contract drawings or specified, even though reviewed by the Architect, shall not relieve the Contractor from furnishing and erecting same.

#### 1.9 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.10 PERMITS, FEE, ETC.:

- A. The Contractor under each section of these specifications shall arrange for a permit from the local authority. The Contractor shall arrange for all utility services, including sewer, water and gas services as applicable. If any charges are made by any of the utility companies due to the work on this project, the Contractor shall pay these charges, including charges for metering, connection, street cutting, etc. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

#### 1.11 LAWS, CODES AND ORDINANCES:

- A. All work shall be executed in strict accordance with all local, state and national codes, ordinances and regulations governing the particular class of work involved, as interpreted by the inspecting authority. The Contractor shall be responsible for the final execution of the work under this heading to suit those requirements. Where these specifications and the accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect, shall prepare any supplemental drawings required illustrating how the work may be installed so as to comply and, on approval, make the changes at no cost to the Owner. On completion of the various portions of the work the installation shall be tested by the constituted authorities, approved and, on completion of the work, the Contractor shall obtain and deliver to the Owner a final certificate of acceptance.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Where stored outside provide pipes and tubes with end caps. Maintain end caps through storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Refer to other Division 23 Sections for additional requirements.

1.13 GUARANTEE:

- A. Unless a longer guarantee is hereinafter called for, all work, material and equipment items shall be guaranteed for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect, shall be repaired and/or replaced to the complete satisfaction of the Architect. Guarantee shall be in writing and in triplicate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
    - a. Where a definite material is mentioned in these specifications, it has been done in order to establish a standard. The product of the particular manufacturer mentioned is of satisfactory construction and any substitution must be of quality as good as or better than the named article. No substitution shall be made without review by the Architect, who will be the sole judge of equality.
    - b. Should a substitution be accepted under the provisions of the conditions of these specifications, and should this substitute prove to be defective or otherwise unsatisfactory for the service for which it is intended within the guarantee period, the Contractor who originally requested the substitution shall replace the substitute material with the specified material.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### PART 3 - EXECUTION

#### 3.1 RELOCATION OF EXISTING INSTALLATIONS:

- A. There are portions of the existing plumbing system, heating, ventilating and air conditioning system which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations which must be relocated to avoid interferences with the installations of new work of his particular trade and that of all other trades. All such existing installations which interfere with new installations shall be relocated by the Contractor under the Division in which the existing material normally belongs, and in a manner as directed by the Architect.
- B. Failure to become familiar with the extent of the relocation work involved shall not relieve the Contractor of responsibility and shall not be used as a basis for additional compensation.

#### 3.2 ACCESS PANELS:

- A. Wherever mechanical and/or plumbing equipment is installed and where future access is required through either walls or ceilings and such cannot be obtained through the removable ceiling or through other means, the Contractor shall provide Milcor Style "M" access doors at least 12 inches by 12 inches in size or larger if required for access. Provide access doors for all fire dampers, smoke dampers, valves, etc. Provide rated access panels as required for installation in rated construction.

#### 3.3 USE OF SYSTEMS:

- A. It is considered that it will be necessary to operate the mechanical systems to provide heating and ventilation in portions of the building that are enclosed. As systems or portions of systems become operable, they shall be operated as required to maintain habitable conditions in enclosed portions of the building that are still under construction and portions that are fully complete as may be required to properly protect installed piping, equipment and finishes.
- B. In order to provide protection to ducts, plenums, etc. install temporary filters over or in return air openings until all finished painting is completed. Protect supply outlets, coils, etc. as necessary in each case.
- C. Except for operation of cooling equipment to prove its performance and to adjust and balance the systems, that equipment will not be operated for comfort of construction workers.
- D. Immediately prior to the time that the systems are to be accepted by the Owner, each system shall be carefully examined and if ductwork is dirty, it shall be carefully cleaned by men skilled in that type of work. All filters shall be put in first class condition by replacement of filters and/or other procedures as directed.



- E. The use of the equipment for maintaining environmental and/or protective temperature conditions shall in no way constitute acceptance of that equipment and the connected piping, ducts, insulation, finishes, etc. by the Owner. Furthermore, it shall in no way shorten the guarantee period hereinafter specified. The Contractor shall either secure extended warranties from the vendors of equipment or shall purchase insurance to provide proper coverage on the equipment through the guarantee period and shall file with the Architect substantiating affidavits from equipment manufacturers or a copy of the insurance policy covering the equipment through the guarantee period. The personal underwriting of the Contractor for equipment manufacturers' warranties is not acceptable, but his personal underwriting of piping, ductwork, insulation and associated materials is acceptable subject to the provisions of the contract.
- F. The Contractor shall provide such labor as may be required in the operation of the systems and shall pay all costs.

#### 3.4 OWNERS OCCUPANCY:

- A. It shall be understood that the building in which the work is to be done is a necessary part of the Owner's operation, and shall continue in use throughout the construction period without interruption. Take all precautions required by the Owner for the protection of his equipment and property.
- B. Contractor shall cooperate with the owner in scheduling areas in which work is permitted. Owners schedule will govern.

#### 3.5 SCHEDULE OF WORK:

- A. The Contractor shall program his work in such manner as to interfere as little as possible with the normal routine of the Owner. It must be understood that the Owner will continue to function throughout the construction period. All water and sanitary facilities shall therefore be continued in operation with a minimum of interruption and the Contractor shall make any temporary connections necessary to comply with this requirement.
- B. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to insure meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates, schedule the times of work in the various areas involved, etc. Each Contractor shall cooperate in establishing these times and locations and shall process his work so as to insure the proper execution of it.
- C. Under no condition shall any work be done in the present building that would interfere with its natural use during its normal hours of occupancy, unless special permission is granted by the Owner. This is particularly applicable where new connections are to be made to present lines or items of equipment in that building or where present equipment items in that building are to be relocated or modified in any way. The Contractor shall include this scheduling requirement in his proposal as no additional compensation for overtime work will be granted.

3.6 WORKING TIME:

- A. Where new connections are to be made into existing lines, present lines must be relocated or rerouted, present equipment items relocated or other work accomplished that would affect the operation of the present building, the work shall be carried on at such times as to cause a minimum of interference with the normal operation of that building. In certain cases the work may be accomplished during normal working hours during certain designated seasons or times of the year. In other cases the work may have to be executed during times of the day outside of the normal working period, on holidays, etc. Each individual case presents a separate decision as to the time during which it shall be performed. The Contractor involved shall present each case to the Architect for his decision, which will be made after due consultation with the Owner. No additional compensation for overtime will be granted for compliance with these requirements.

3.7 ELECTRICAL WIRING:

- A. All electric wiring of every character, except for temperature control, shall be done under Division 26 of these specifications. The Contractor for each section shall erect all his motors in place ready for connections. The Contractor, under Division 26, shall mount all the starters and controls, furnishing the supporting structures and any required outlet boxes.
- B. Every electrical current consuming device furnished as a part of this project, or furnished by the Owner and installed in this project, shall be completely wired up under Division 26. Verification of exact location, method of connection, number and size of wires required, voltage requirements, and phase requirements is the responsibility of the Contractor under Division 26. If conflicts occur between the drawings and the actual requirements, actual requirements shall govern.

3.8 SEALING AROUND PIPES, DUCTS, ETC.:

- A. The Contractor installing pipes, ducts, etc. shall seal all spaces between pipes and/or sleeves where they pierce walls, partitions or floors with Johns-Manville Firetemp CI intumescent caulk or as directed by architect. The packing shall effect a complete fire and/or air seal where pipes, ducts, etc., pierce walls, floors or partitions.

3.9 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

- D. Install equipment to allow right of way for piping installed at required slope.
- E. Rough-In and Final Connection for Equipment:
  - 1. The shop drawings for all equipment are hereby made a part of these specifications. The Contractor under each section of the specifications shall rough-in for the exact item to be furnished on the job, whether in another section of the specifications or by the Owner. The Contractor shall refer to all drawings and other sections of the specifications for the scope of work involved for the new equipment, and by actual site examination determine the scope of the required equipment connections for the Owner furnished equipment.
  - 2. Should any of the equipment furnished require connections of a nature different from that shown on the drawings, report the matter to the Architect and finally connect as directed by the Architect.
  - 3. Should any shop drawings not be available for equipment furnished under other contracts or by the Owner, the Contractor under each section of these specifications shall bid the work as detailed on the drawings.
  - 4. Minor differences in the equipment furnished and that indicated on the drawings will not constitute ground for additional payment to the Contractor.

### 3.10 PROGRESS OF WORK:

- A. The Contractor shall keep himself fully informed as to the progress of the work and do his work at the proper time without waiting for notification from the Architect or Owner.

### 3.11 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

### 3.12 MANUFACTURER'S DIRECTIONS:

- A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer.

### 3.13 MATERIALS AND WORKMANSHIP:

- A. All materials shall be new unless otherwise specified and of the quality specified. Materials shall be free from defects. All materials of a type for which the Underwriters Laboratories, Inc. have established a standard shall be listed by the Underwriters Laboratories, Inc. and shall bear their label.

- B. Wherever the make of material or apparatus required is not definitely specified, the Contractor shall submit a sample to the Architect before proceeding.
- C. The Architect reserves the right to call for samples of any item of material offered in substitution, together with a sample of the specified material, when, in the Architect's opinion, the quality of the material and/or the appearance is involved and it is deemed that an evaluation of the two materials may be better made by visual inspection. This shall be limited to plumbing brass, grilles, registers, ceiling outlets and similar items and shall not be applicable to major manufacturers' items of equipment.
- D. The Contractor shall be responsible for transportation of his materials to and on the job, and shall be responsible for the storage and protection of these materials and work until the final acceptance of the job.
- E. The Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds, and all labor required for the safe and expeditious execution of his contract.
- F. The workmanship shall in all respects be of the highest grade and all construction shall be done according to the best practice of the trade.

#### 3.14 PROTECTION OF APPARATUS:

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect his new apparatus from damage. This shall include the erection of all required temporary shelters to adequately protect any apparatus stored in the open on the site, the cribbing of any apparatus above the floor of the construction, and the covering of apparatus in the incompleting building with tarpaulines or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Architect will be sufficient cause for the rejection of the pieces of apparatus in question.

#### 3.15 COOPERATION AND CLEANING UP:

- A. The contractor for the work under each section of these specifications shall coordinate his work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.
- B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

3.16 COORDINATION OF TRADES:

- A. The Contractor shall be responsible for resolving all coordination required between trades. For example, items furnished under Division 23 which require electrical connections shall be coordinated with Division 26 for:
  - 1. Voltage
  - 2. Phase
  - 3. Ampacity
  - 4. No. and size of wires
  - 5. Wiring diagrams
  - 6. Starter size, details and location
  - 7. Control devices and details
- B. Items furnished under various sections which require plumbing connections shall be coordinated for services, pressure, size and location of connections, type of fuel, clearances for service, auxiliary devices required, etc.
- C. Items requiring insulation shall be fully insulated and that insulation shall be checked against manufacturer's directions and job requirements for suitability, coverage, thickness and finish.
- D. Items installed in/on finished ceilings shall be coordinated with the ceiling construction. The Contractor under each section shall conform to the reflected ceiling plan and shall secure details and/or samples of the ceiling materials as necessary to insure compatibility. Any device not conforming to this requirement shall be replaced by the Contractor at his expense.
- E. All items specified under Division 23 shall be installed tight, plumb, level, square and symmetrically placed in relation to the work of other trades.

3.17 TESTING:

- A. The Contractor under each division shall at his own expense perform the various tests as specified and required by the Architect and as required by the State and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests. Notify the Architect a minimum of 24 hours in advance of all tests.

3.18 PAINTING

- A. All painting shall be done by the Contractor under Division 09. Following is a general outline of the required work for Division 23.
  - 1. When the factory finish on any apparatus or equipment is marred, it shall be touched up and then given one coat of half flat half enamel, followed by a coat of machinery enamel of a color to match the original. Paint factory primed surfaces.
  - 2. Paint all exposed pipe, cabinets, hangers and supports and miscellaneous metal.
  - 3. Paint all exposed sheet metal.
  - 4. Paint all insulated surfaces exposed to view, including piping, equipment, etc. Size surfaces until a smooth, non grainy surface is obtained.

5. Generally, painting is required on all surfaces such that no exposed bare metal or insulation surface is visible.
6. Paint all surfaces above or behind perforated return air grilles or other open spaced air outlet devices with flat black paint. All pipes, conduits, ductwork and structural members shall be painted. These surfaces shall be painted a distance away from the grille such that no unpainted surfaces are visible to a person standing on the room side and viewing through the device.

3.19 INSTALLATION DRAWINGS:

- A. It shall be incumbent upon the Contractor to prepare special drawings as called for elsewhere herein or as directed by the Architect to coordinate the work under each section, to illustrate changes in his work, to facilitate its concealment in finished spaces to avoid obstructions or to illustrate the adaptability of any item of equipment which he proposes to use.
- B. These drawings shall be used in the field for the actual installation of the work. Unless otherwise directed, they shall not be submitted for approval but three copies shall be provided to the Architect for his information.

3.20 OPERATING INSTRUCTIONS:

- A. The Contractor for each section of the work hereunder shall, in cooperation with the representatives of the manufacturers of the various equipment items, carefully instruct the Owner's representatives in the proper operation of each item of equipment and of each system. During the balancing and adjusting of systems, the Owner's representative shall be made familiar with all procedures.
- B. The contractor shall coordinate the date and time for the training with the Owner's representative and shall document attendance with a sign-in sheet. At a minimum, the sign-in sheet shall indicate the date and location of the session, name and organization of each participant, and a list of any material that may be provided. This information shall be provided to the Architect as part of the closeout documents. Failure to provide documentation of training may require the contractor to provide a subsequent training session.

3.21 OPERATING MANUALS:

- A. Prepare and submit 3 copies of the operating manuals bound in hard covers. Three weeks prior to completion of the work, the Architect will check the manuals and any additional material necessary to complete the manuals shall be furnished and inserted by the Contractor.
- B. Manuals shall contain the following data:
  1. Catalogue data of all equipment.
  2. Shop drawings of all equipment.
  3. Temperature control drawings (reduced in size)
  4. Start-up instructions for major equipment.

5. Trouble shooting procedures for major equipment.
6. Wiring diagrams.
7. Recommended maintenance schedule for equipment.
8. Parts list for all items.
9. Name and address of each vendor.

3.22 COMPLETION REQUIREMENTS:

- A. Before acceptance and final payment the Contractor under each Division of the specifications shall furnish:
1. Accurate record drawings, shown in red ink on blue line prints furnished for that purpose all changes from the original plans made during installation of the work. Drawings shall be filed with the Architect when the work is completed.
  2. All manufacturers' guarantees.
  3. All operating manuals.
  4. Guarantees.
  5. Test and Balance Report.

3.23 CONTRACTOR'S RESPONSIBILITY FOR FINAL INSPECTION:

1. Before calling for the final inspection, the Contractor under each Division shall carefully inspect his work to be sure it is complete and according to plans and specifications.

END OF SECTION 23 05 00

## SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Manual balancing damper flags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: White.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.



5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

## 2.2 MBD FLAGS

A. Material: Fluorescent yellow 1-3/16" wide plastic flagging tape

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 DUCT MBD FLAG INSTALLATION

A. Install plastic flags at each manual balancing damper to hang a minimum of 12" below bottom of the duct.

END OF SECTION 23 05 53

## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.

E. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

## 1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## 1.6 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check dampers for proper position to achieve desired airflow path.

- F. Check for airflow blockages.
- G. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

- C. Measure air outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
  - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
  - 1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
  - 1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
  - 2. Verify sufficient inlet static pressure before making volume adjustments.
  - 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not overpressurize ducts.
- E. Remeasure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

### 3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. **Compensating for Diversity:** When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow

of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record final fan-performance data.

### 3.8 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.



### 3.9 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent to minus 0 percent.
  - 2. Air Outlets and Inlets: Plus or minus 5 percent but with each room/zone totaling plus 5 or minus 0 percent..

### 3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Manufacturers' test data.
  - 2. Field test reports prepared by system and equipment installers.
  - 3. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB contractor.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  2. Motor Data:

- a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.

F. Air-Terminal-Device Reports:

1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Apparatus used for test.
  - d. Area served.
  - e. Number from system diagram.
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Preliminary air flow rate as needed in cfm.
  - c. Final air flow rate in cfm.
  - d. Space temperature in deg F.

3.12 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

- B. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
  2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
  3. Architect or Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
  4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

### 3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply air.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## 1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite XG.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Owens Corning; SOFTR All-Service Duct Wrap.

### 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

## 2.4 SEALANTS

### A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

## 2.5 FACTORY-APPLIED JACKETS

### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 TAPES

### A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ABI, Ideal Tape Division; 491 AWF FSK.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - c. Compac Corporation; 110 and 111.
  - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.



5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## 2.7 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, [Type 304] [or] [Type 316]; 0.015 inch thick, [1/2 inch] [3/4 inch] wide with [wing seal] [or] [closed seal].

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness

indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
    - 2) GEMCO; Peel & Press.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.

- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.

- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
  - 2. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions larger than 22 inches, place pins 18 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - b. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - c. Do not overcompress insulation during installation.
  - d. Impale insulation over pins and attach speed washers.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
3. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 FIELD QUALITY CONTROL

- A. The installation of all thermal insulation shall be performed by a recognized firm regularly engaged in the insulation business, using skilled insulation mechanics and using insulation materials which are the product of reputable manufacturer of the materials, using any special materials as required by these specifications and by those published standards.
- B. Any insulation which is not applied in a workmanlike manner will be rejected and replaced. All coverings shall be smooth, flush, dressed to line and tight. Mastic shall be neatly applied and tooled. The Architect reserves the right to reject any insulation whose appearance he deems unacceptable.

### 3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, concealed supply air.

- B. Items Not Insulated:
  - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums and casings.
  - 4. Flexible connectors.
  - 5. Vibration-control devices.
  - 6. Factory-insulated access panels and doors.

### 3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, rectangular, supply air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft nominal density.

END OF SECTION 23 07 13

## SECTION 23 31 13 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and flat-oval ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Adhesives.
  - 2. Sealants and gaskets.

### PART 2 - PRODUCTS

#### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Lewis & Lambert.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 36 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements,



materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 35 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- C. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

### 3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.5 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09.

### 3.6 DUCT CLEANING

- A. During construction, keep duct materials and all portions of installed duct systems clean and free of debris. If material is not kept clean, the contractor shall be responsible for cleaning all ductwork as determined by the Owner and/or Architect. If required, clean new duct system(s) before testing, adjusting, and balancing as indicated below.

### 3.7 START UP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

### 3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

- 1. Lab Exhaust Ducts: Stainless Steel.

- B. Supply Ducts:

- 1. Ducts Connected to Terminal Units :
  - a. Pressure Class: Positive 1-inch wg.
  - b. Minimum SMACNA Seal Class: B.
  - c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round and Flat Oval: 6.

- C. Return Ducts:

- 1. Return and Transfer Air Ducts:
  - a. Pressure Class: Positive or negative 1-inch wg.
  - b. Minimum SMACNA Seal Class: B.
  - c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round and Flat Oval: 6.

- D. Exhaust Ducts:

- 1. Ducts Connected to Fans:
  - a. Pressure Class: Negative 3-inch wg.
  - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
  - c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- 2. Ducts Connected to Fans Exhausting Laboratory and Process Air:
  - a. Type 316 or Type 304, stainless-steel sheet.
    - 1) Exposed to View: No. 4 finish.
    - 2) Concealed: No. 2B or No. 2D finish.
  - b. Pressure Class: Positive or negative 3-inch wg.
  - c. Minimum SMACNA Seal Class: A.
  - d. SMACNA Leakage Class: 3.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. 45 or 90-degree tap and conical tap as indicated on the drawings.

END OF SECTION 23 31 13

## SECTION 23 33 00 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Manual volume dampers.
  - 2. Turning vanes.
  - 3. Flexible ducts.
  - 4. Duct accessory hardware.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

#### 2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.

- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. McGill AirFlow LLC.
    - c. Nailor Industries Inc.
    - d. Pottorff.
    - e. Ruskin Company.
    - f. Trox USA Inc.
    - g. Vent Products Company, Inc.
  - 2. Standard leakage rating.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized-steel, 0.064 inch thick.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Oil-impregnated bronze or molded synthetic.
  - 8. Tie Bars and Brackets: Galvanized steel.
- B. Low-Leakage Manual Volume Dampers:
- C. Jackshaft:
  - 1. Size: 0.5-inch diameter.



2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.4 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall.

## 2.5 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct for Medium and High Pressure Systems: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 12-inch wg positive and 5-inch wg negative.
  2. Maximum Air Velocity: 5500 fpm.
  3. Temperature Range: Minus 10 to plus 160 deg F.
  4. Insulation R-value: R-6.
- C. Insulated, Flexible Duct for Low Pressure Systems: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 6inch wg positive and 4-inch wg negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 20 to plus 175 deg F.
  4. Insulation R-Value: R-6.
- D. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size. Refer to Drawings for required type.

## 2.6 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts as required to afford complete control of the air flow in the various duct systems. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
1. Install steel volume dampers in steel ducts.

- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- G. Connect diffusers or light troffer boots to ducts directly or with maximum 48-inch lengths of flexible duct clamped or strapped in place.
- H. Connect flexible ducts to metal ducts with draw bands.
- I. Install duct test holes where required for testing and balancing purposes.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Inspect turning vanes for proper and secure installation.
  - 4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

## SECTION 23 36 00 – AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Dual duct variable or constant volume terminal units.

#### 1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
  - 2. UL 181 - Factory-Made Air Ducts and Connectors.
  - 3. AHRI Standard 410 - Forced-Circulation Air-Cooling and Air-Heating Coils
  - 4. AHRI Standard 880 – Performance Rating of Air Terminals.
  - 5. AHRI Standard 885 – Procedures for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
  - 6. ANSI/ASHRAE Standard 130 – Methods of Testing for Rating Ducted Air Terminal Units.
  - 7. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Shop Drawings of product data indicating configuration, general assembly, access space required for service, and materials used in fabrication.
  - 2. Electronic or Printed Catalog performance ratings that indicate nominal inlet size, CFM, applicable static pressure at the inlet or discharge of terminal unit, and

noise criteria with sound octave band and sound decibel test in accordance with ARI 880, for the insulation lining selected.

3. Leakage curves indicating inlet static pressure and actual tested leakage rates shall be submitted for all non-standard or custom-built terminal units.
4. Unit manufacturer shall test and certify that each terminal unit used on this Project has been tested as specified.

B. Operation and Maintenance Data:

1. Operating instructions and maintenance manuals indicating maintenance and repair data, parts lists.

### 1.5 SHIPMENT TESTING PRIOR TO INSTALLATION

A. Shipment Testing: At the Owner's discretion, a minimum of ten (10) percent of each size single duct terminal unit (but no less than one unit of each size on the Project) will be tested at the Project Site for casing leakage and damper leakage. Fan powered terminals units will be tested for damper leakage and for conformance to this Specification. Contractor shall allow sufficient time during construction for the TAB Firm to perform all testing as may be required.

B. Unit Non-Performance:

1. If results of the shipment testing show that any of the units do not perform as specified, then an additional ten (10) percent of each size unit (but no less than one unit of a size, unless 100 percent of the size has been tested) shall be tested.
2. If this testing, in the Owner's opinion, shows that ten (10) percent or more of the units tested do not perform as specified, then 100 percent of all unit sizes shall be tested for conformance with these Specifications.
3. The results of that testing shall be reviewed carefully between the Contractor, manufacturer, Owner, and Engineer. A method of repair or replacement of units will be negotiated. The Owner, however, shall maintain the right of final approval of any proposed solution.

C. Should for any reason, the testing as described in this Section prove that any of the units do not perform as specified, Contractor shall be responsible for all subsequent labor, travel, travel expenses and incidental expenses, penalties, or other costs attendant to any additional testing as described in this Section, or as required to prove that the units perform as specified. This shall include, but not be limited to, the labor, travel and reasonable incidental expenses of not only the Contractor and TAB Firm, but also those incurred by the Owner as may be specifically required for this purpose.

### 1.6 WARRANTY

A. Provide one year manufacturer's warranty under provisions of Division 01.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Dual Duct Terminal Units: All dual duct terminal units shall be as manufactured by Metal\*Aire (Series DH-500).

### 2.2 VARIABLE OR CONSTANT VOLUME DUAL DUCT TERMINAL UNITS

- A. The Contractor shall provide pressure independent dual duct variable air volume control assemblies as scheduled with integral attenuator/mixers of the sizes, capacities, and configurations shown on the drawings.

- B. CASING CONSTRUCTION:

1. The units shall be constructed of a minimum of 22-gauge galvanized steel and internally lined with a minimum of 1 inch thick, three pound per cubic foot density insulation.
  - a. The insulation shall be foil faced with the edges and seams sealed or "captured", encapsulating all fibers of the insulation.
  - b. Insulation shall meet NFPA-90A requirements for flame spread and smoke generation and UL-181 requirements for anti-erosion, corrosion and fungus properties.
  - c. The insulation shall be neatly installed with no rough edges to interrupt the smooth flow of air through the box.
  - d. Closed cell polymer insulation may be used instead of the fiberglass described above if UL 25/50 labeled.
  - e. The casing shall be insulated throughout its interior.
  - f. The external insulation shall be as specified in other sections of this specification for duct insulation with full vapor barrier, and shall be field installed unless coil and plenum section is furnished as an integral part of the box.
2. All interior features of the boxes (such as mixing baffles, damper housings, etc.) shall be secured within the casing to avoid excessive movement or rattling with air movement or externally generated vibration. All external features of the terminal units shall be designed not to extend beyond the ends of the unit. (For example, the actuator mounting brackets, etc. shall not extend beyond the plane of the inlet "bulkhead.") The only exception shall be flow sensors installed in the inlet duct connections. Note that if a separate flow station is installed within a frame within the casing, then it shall be so installed not to allow airflow to bypass the flow measurement station.
3. No portion of the VAV terminal shall block access to the flow ring connections on the unit inlets. Note that this will require some manufacturers to mount their control panels further forward than their standard construction.
4. The terminal units shall be constructed with inlet and discharge ductwork connections.

- a. The inlet ductwork connections shall extend a minimum of 4 inches from the unit casing including an allowance for the installation of airflow station(s) or probe(s).
- b. The discharge connection shall include 1" extension with slip and drive connections for use by the Contractor to secure the discharge ductwork or appurtenances to the unit and shall be reinforced to provide a rigid assembly.

C. CASING LEAKAGE:

- 1. Assembled units shall be so constructed and sealed to limit air leakage to the following listed quantities at 6" static pressure. The units shall be tested for leakage in both inlets with 6" static pressure imposed on one inlet at a time. The maximum percent leakage from all tests shall be reported.
- 2. If sealing is required to obtain the leakage performance, seal as for medium pressure ductwork Hardcast 1602 tape may be used to seal lap joints and flat seams only. Leakage curves or tables will be required as part of the submittal data. The following is the maximum allowable casing leakage including all components:

<b>Diameter</b>	<b>Maximum CFM (@ 2000 fpm inlet velocity)</b>	<b>Maximum Allowable CFM Casing Leakage</b>
<b>4"-5"-6"</b>	395	8.0
<b>7"-8"</b>	700	14.0
<b>9"-10"</b>	1090	22.0
<b>11"-12"</b>	1570	30.0
<b>13"-14"</b>	2140	40.0

D. ACCESS PLENUM AND DOOR:

- 1. An access panel shall be provided immediately downstream of the dampers for inspection and service of the dampers.
- 2. The access doors shall be a minimum of a 12 inch diameter or 12 inch by 12 inch (or full width of unit if less than 12").
  - a. The door shall be Ventlok Galvanized Sheet Metal Access Door, Flexmaster Inspector Series, Ward DSP or DSA series, or equal.
  - b. The door frame may be bolted, screwed or flanged and sealed to the casing.
  - c. The door shall be gasketed and shall be double wall construction or insulated similar to main casing.
  - d. The door shall be held in place with latches or other captive retainer devices.
  - e. If the damper assembly is easily removed from the rear of the box, the access size can be reduced to 8" round or 8" x 8" for inspection only.
- 3. Access doors and frames shall be thermally broken.

E. DAMPER CONSTRUCTION:

1. The damper blades shall be an equivalent of 18-gauge galvanized steel or equal aluminum and shall be securely riveted or bolted through the damper shafts to assure no slippage of the blades.
2. The damper shafts shall be round and operate in sintered bronze self-lubricating bearings. The end of the shaft at the operator end shall be scored in line with the damper blade to reference the damper blade position.
3. Damper shafts penetrating the unit casings shall be sealed against leakage, and bearings shall be installed for protection against wear in the casing penetration.
4. Damper shafts shall be formed of, or cut from solid stock; no hollow shafts will be allowed.
5. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges. Gaskets shall be mechanically fastened to the blades. If the fastening method is not full contact clamping type, then the addition of adhesive to the gasket shall be required.
6. The dampers shall be so constructed to prevent "oil canning" of the damper blade.
7. The units shall be tested for leakage in both inlets with 6" static pressure imposed on one inlet at a time. The maximum percent leakage from all tests shall be reported. Leakage curves as a function of pressure shall be supplied as part of the submittal data. The damper actuator linkage, if used, shall be constructed of material of sufficient strength to avoid buckling under extreme loads. Also, linkages shall not allow play greater than 5 degrees of damper movement. The controls for the dampers shall cause the dampers to fail in the position of last control (freeze in place), or fail to the open position.

F. DAMPER LEAKAGE:

1. The following is the maximum damper leakage allowable for the various size diameter inlets at 6" wg differential pressure. The damper leakage shall not exceed the values listed in the table below at 6" S.P., following ARI 880 Testing Procedures.

<b>Diameter</b>	<b>Maximum CFM (@ 2000 fpm inlet velocity)</b>	<b>Maximum Allowable CFM Damper Leakage</b>
<b>4"-5"-6"</b>	395	6
<b>7"-8"</b>	700	10.5
<b>9"-10"</b>	1090	16.5
<b>11"-12"</b>	1570	20
<b>13"-14"</b>	2140	30

G. UNIT PRESSURE DROP:

1. For dual duct units with an integral attenuator-mixer, but with no other accessories, the static pressure across the assembly with an equivalent 2000 fpm inlet velocity through one inlet shall not exceed 0.5 inches water gauge, with the total flow through either inlet.

H. CERTIFICATION:



1. The Unit Manufacturer shall certify that each unit used on this project will perform as specified. Each unit shall bear a tag or decal listing the following specified information:
    - a. Test Pressure
    - b. Leakage CFM (damper)
    - c. Leakage CFM (casing)
    - d. Date of Mfg.
    - e. Room or area served
    - f. Unit size - 6", 8", etc.
    - g. Calibrated CFM, i.e. 800 CFM
- I. MIXING:
1. Terminal units as specified herein shall provide mixing within the units, and not rely upon the discharge ductwork to provide for the completion of the mixing process.
  2. The horizontal average temperature of the air as it leaves the terminal unit shall not vary more than 1°F for each 20°F. of temperature difference between the two inlet air supplies. (For example, if the cold supply air is 55°F. and the hot supply air is 95°F., the difference is 40 degrees. The allowable temperature variation of the discharge air is, thus, 2°F.)
  3. The temperature of the discharge air shall be measured using a pattern of four vertical, evenly spaced columns, and three horizontal, evenly spaced rows. The rows and columns shall be spaced so that the resulting 12 points shall be at the centers of equal areas. The plane of the points shall be perpendicular to the direction of airflow, within 4 inches of the discharge of the terminal unit, within the discharge ductwork. The three readings in each column shall be averaged to determine compliance with the 1° criteria.
- J. FLOW MEASUREMENT:
1. Airflow measurement systems shall measure airflow through the inlet connections with 5% of actual airflow between 2000 fpm and 250 fpm with three straight duct diameters on each air inlet connection.
  2. Provide external differential pressure taps separate from the control pressure taps for airflow measurement with a 0"-1" w.g. range.
  3. Where flow measurement is indicated to be on the discharge side of the air terminal, the manufacturer is responsible for locating the flow measurement device so that it meets the accuracy requirements above from the minimum to the maximum settings for the box and each deck connection.
  4. As a substitute, the manufacturer and contractor may elect to provide an external flow measure device and required duct modifications at no additional cost to the owner.
- K. SOUND: Note that the maximum sound levels listed in this paragraph refer to raw sound levels, with no credits taken for the construction.
1. DISCHARGE SOUND:
    - a. Maximum discharge Sound Power Levels at 2000 fpm primary air inlet velocity with 1.5 inch wg inlet static pressure shall not exceed that listed in the following table. No credit for lined discharge duct, branching, flow

division, end reflection, room absorption or any other effects shall be allowed.

<b>Octave Band</b>	<b>Center Frequency (Hz)</b>	<b>Sound Power Level (dB re 10-12 Watts)</b>
<b>2</b>	125	76
<b>3</b>	250	66
<b>4</b>	500	63
<b>5</b>	1000	58
<b>6</b>	2000	60
<b>7</b>	4000	55

2. **RADIATED SOUND:**

- a. Maximum discharge Sound Power Levels at 2000 fpm primary air inlet velocity with 1.5 inch wg inlet static pressure shall not exceed that listed in the following table. No credit for ceiling plenum, ceiling tiles, room absorption, or any other effects shall be allowed.

<b>Octave Band</b>	<b>Center Frequency (Hz)</b>	<b>Sound Power Level (dB re 10-12 Watts)</b>
<b>2</b>	125	72
<b>3</b>	250	67
<b>4</b>	500	64
<b>5</b>	1000	54
<b>6</b>	2000	47
<b>7</b>	4000	45

- b. All sound power levels shall be obtained from testing in accordance with ARI-ADC Standard 880 and shall be certified at ARI-880 certification points.

L. **CONTROLS:**

1. Provide unit with single point electrical connection.
2. If DDC controls of another Manufacturer (NOT the terminal unit Manufacturer) are provided for this project, the terminal unit Manufacturer shall be responsible only for the construction of the terminal unit and the installation of internal control components installed at the Manufacturer's factory, and shall not be responsible for the installation of controls not installed at the terminal unit Manufacturer's factory, nor shall the Manufacturer be responsible for the performance of the DDC controls.
3. If used, Controls Contractor furnished flow stations shall be furnished, mounted and adjusted by the Controls Contractor with assistance from the Terminal Unit Manufacturer to assure their proper placement.
4. Electronic motors and controllers shall be installed by the terminal unit Manufacturer unless specifically prohibited by the by the controls Manufacturer. In such an event, the controls Manufacturer shall be responsible for the installation of the controls.

5. The Controls Manufacturer shall be responsible for the operational performance of the entire system. The terminal unit Manufacturer shall remain responsible only for the performance of the mechanical components of the unit.
6. Refer to the Controls Drawings for sequences of operations.
7. Devices using mechanical CFM limiters will not be accepted, nor shall it be necessary to change control components to make airflow rate changes.

M. CONTROLS PERFORMANCE:

1. Units shall be capable of controlling air volume to within plus or minus 5% of air volume setpoint, as determined by the zone temperature sensor demand with variations in inlet pressures from 0.10" to 6" w.g.
2. Assemblies shall be able to be reset to any airflow between zero and the maximum cfm shown on Drawings.
3. To allow for maximum flexibility and future changes, it shall be necessary to make only simple screwdriver or keyboard adjustments to arrange each unit for any maximum airflow within the ranges for each inlet size as scheduled on the Drawings.
4. The control devices shall be designed to maintain the desired flow regardless of inlet flow deflection.

PART 3 - EXECUTION

3.1 TESTING PRIOR TO INSTALLATION

- A. Refer to Submittal Paragraph (in Part 1 of this section) for sample unit testing prior to shipment.

B. SHIPMENT TESTING:

1. A minimum of ten percent (10%) of each size of the terminal units (but no less than one unit of each size used) may be tested for conformance to this specification, at the Owner's discretion. The Contractor shall allow sufficient time during construction and space for the Owner's TAB Consultant to perform all testing as may be required.

C. UNIT NON-PERFORMANCE:

1. If the results of the SHIPMENT TESTING show that any of the units do not perform as specified, then an additional ten percent (10%) of each size (but no less than one unit of a size, unless 100% of the size has been tested) of the units shall be tested. If this testing, in the Owner's opinion, shows that ten percent (10%) or more of the units tested do not perform as specified, then one hundred percent (100%) of all sizes of the units shall be tested for conformance with these specifications. The results of that testing shall be reviewed carefully between the Contractor, Manufacturer, the Owner's construction administrator(s), and the Owner's design engineer(s). A method of repair or replacing the units will be negotiated. The Owner, however, shall maintain the right of final approval of any proposed solution.

2. Should for any reason the testing described above under "SUBMITTAL" and "SHIPMENT TESTING" prove that any of the units do not perform as specified, the Contractor shall be responsible for all subsequent labor, travel, travel expenses, and incidental expenses, penalties, or other costs attendant to any additional testing as described under "UNIT NON-PERFORMANCE", or as required to prove that the units perform as specified. This shall include, but not be limited to, the labor, travel and reasonable incidental expenses of not only the Contractor and Owner's TAB Consultant, but also those incurred by the Owner as may be specifically required for this purpose. The expenses to be reimbursed to the Owner shall be labor at a rate of \$300 per day or any portion of a day, plus travel and travel expenses at actual cost, plus reasonable incidental expenses at actual cost.
3. All coils shall be constructed and tested in accordance with UL and/or ARI Standards. The tube ends shall be protected with tube end caps of sheet metal similar to the casing material, and shall be insulated within the caps.

### 3.2 INSTALLATION

- A. Refer also to requirements included in Part 2 of this specification.
- B. Install in accordance with Manufacturer's instructions.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure. Do not support from adjacent ductwork.
- E. Connect to ductwork in accordance with Division 23 Ductwork specification.
- F. All terminal units shall be installed with manufacturer's minimum straight duct inlet requirements or 3 duct diameters of straight run, whichever is larger.
- G. Maintain NEC and manufacturer's recommended clearances for control enclosures.

END OF SECTION 23 36 00

## SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. All air distribution devices as scheduled on the drawings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

### PART 2 - PRODUCTS

#### 2.1 CEILING DIFFUSERS

- A. Diffuser, Grilles and Registers:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. METALAIRE, Inc.
    - b. Nailor Industries Inc.
    - c. Price Industries.
    - d. Titus.

#### 2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

#### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

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## SECTION 26 05 00 – GENERAL PROVISIONS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.

#### 1.3 DEFINITIONS

- A. "Furnish, Provide, Install": Whenever the words "furnish", "provide", "furnish and install," "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.
- B. Materials: Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. "Shall": The use of the word "shall" conveys a mandatory condition to the contract.
- D. "Section": "This section" always refers to the section in which the statement occurs.
- E. "Project": "The project" includes all work in progress during the construction period.
- F. Multiple Items: In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

#### 1.4 ELECTRICAL LINES:

- A. General: In general, the electrical lines to be installed under these Specifications shall be run as indicated, as specified herein, as required by particular conditions at the site, and as required to conform to the generally accepted standards as to complete the work in a neat and satisfactorily workable manner. The following is a general outline concerning the running of electrical lines and is to be excepted where the drawings or conditions at the building necessitate deviating from these standards.



- B. General Construction: The Contractor shall thoroughly acquaint himself with the details of the construction and finishes before submitting his bid as no allowances will be made because of the Contractor's unfamiliarity with these details. Place all inserts in masonry walls while they are under construction. All concealed lines shall be installed as required by the pace of the general construction to precede that general construction.
- C. Field Conditions: The electrical Drawings do not give exact details as to elevations of electrical lines, exact locations, etc., and do not show all the offsets, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the architectural and structural conditions, to avoid all obstruction, to conform to details of installation supplied by the manufacturers of the equipment to be installed, and thereby to provide an integrated, satisfactorily operating installation.
- D. Locations of Electrical Devices: The electrical Drawings show diagrammatically the locations of the various electrical outlets and apparatus and the method of circuiting and controlling them. Exact locations of these outlets and apparatus shall be determined by reference to the general Drawings and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with other sections, and in all cases shall be subject to the approval of the Architect. The Architect reserves the right to make any reasonable change in location of any outlet or apparatus before installation (within 10 feet of location shown on drawings) or after installation if an obvious conflict exists, without additional cost to the Owner.
- E. Space Requirements: The Contractor shall be responsible for the proper fitting of his material and apparatus into the space. Should the particular equipment that any bidder proposes to install require other space conditions than those indicated on the drawings, he shall arrange for such space with the Architect before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make such necessary changes at his (the Contractor's) own expense.
- F. Working Drawings: The Contractor shall submit scale working drawings of all his apparatus and equipment which in any way varies from these Specifications and Drawings. The Architect shall check these variations from the Specifications and Drawings before the work is started. Before the work proceeds, the contractor shall correct any interference with the structural conditions.
- G. Order of Precedence: Order of precedence shall be observed in laying-out the conduit in order to fit the material into the space above the ceiling and in the chases and walls. The installation shall be coordinated with the work of all other trades. The following order shall govern:
1. Items affecting the visual appearance of the inside of the building such as lighting fixtures, outlets, panelboards, etc. Coordinate all items to avoid conflicts at the site.
  2. Lines requiring grade to function such as sewers.
  3. Large ducts and pipes with critical clearances.
  4. Conduit, water lines, and other lines whose routing is not critical and whose function bends and offsets would not impair.

- H. Equipment Connections: Conduits serving outlets on items of equipment shall be run in the most appropriate manner. Where the equipment has built-in chases, the lines shall be contained therein. Where the equipment is of the open type, the lines shall be run as close as possible to the underside of the top and in a neat and inconspicuous manner.
- I. Exceptions and Inconsistencies: Exceptions and inconsistencies in Drawings and Specifications shall be brought to the Architect's attention before the contract is signed. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus, material, or equipment.
- J. Intent of Drawings and Specifications: The Contractor shall distinctly understand that the work described herein and shown on the accompanying drawings shall result in a finished and working job, and any item required to accomplish this intent shall be included whether specifically mentioned or not.
- K. Examination of Drawings and Specifications: Each bidder shall examine the Drawings and Specifications for the General Construction. If these documents show any item requiring work under Division 26 and that work is not indicated on the respective Electrical drawings, he shall notify the Architect in sufficient time to clarify before bidding. If no notification is received, the Contractor is assumed to require no clarification, and shall install the work as indicated on the General Drawings in accordance with the Specifications.

#### 1.5 DIMENSIONS:

- A. General: Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings. Any difference that may be found shall be submitted to the Architect for consideration before proceeding with the work.

#### 1.6 INSPECTION OF SITE:

- A. General: The accompanying Drawings do not indicate completely the existing electrical installations. The bidders for the work under these sections of the Specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.7 ELECTRICAL WIRING:

- A. Description: All electric wiring of every character, both for power supply, for pilot and control, for temperature control, for communications, etc. will be done under Division 26 of these Specifications. Every electrical current consuming device furnished as a part of this project, or furnished by the Owner and installed in this project, shall be completely wired up under Division 26. Verification of exact location, method of connection, number and size of wires required, voltage requirements, and phase requirements is the responsibility of the Contractor under Division 26. If conflicts occur between the drawings and the actual requirements, actual requirements shall govern.

1.8 PROGRESS OF WORK:

- A. General: The Contractor shall keep himself fully informed as to the progress of the work and do his work at the proper time without waiting for notification from the Architect or Owner.

1.9 MANUFACTURER'S DIRECTIONS:

- A. General: All manufactured articles shall be applied, installed and handled as recommended by the manufacturer.

1.10 MATERIALS AND WORKMANSHIP:

- A. Materials: All materials shall be new unless otherwise specified and of the quality specified. Materials shall be free from defects and undamaged. All materials of a type for which the Underwriters Laboratories, Inc. have established a standard shall be listed by the Underwriters Laboratories, Inc. and shall bear their label.
- B. Samples: The Architect reserves the right to call for samples of any item of material offered in substitution, together with a sample of the specified material, when, in the Architect's opinion, the quality of the material and/or the appearance is involved and it is deemed that an evaluation of the two materials may be better made by visual inspection. This shall be limited to lighting fixtures, wiring devices, and similar items and shall not be applicable to major manufacturers' items of equipment.
- C. Transportation: The Contractor shall be responsible for transportation of his materials to and on the job, and shall be responsible for the storage and protection of these materials and work until the final acceptance of the job.
- D. Appurtenances: The Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds, and all labor required for the safe and expeditious execution of his contract.
- E. Workmanship: The workmanship shall in all respects be of the highest grade and all construction shall be done according to the best practice of the trade.

1.11 PROTECTION OF APPARATUS:

- A. General: The Contractor shall at all times take such precautions as may be necessary to properly protect his new apparatus from damage. This shall include the erection of all required temporary shelters to adequately protect any apparatus stored in the open on the site, the cribbing of any apparatus above the floor of the construction, and the covering of apparatus in the uncompleted building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Architect will be sufficient cause for the rejection of the pieces of apparatus in question.

1.12 PERMITS, FEE, ETC.:

- A. General: The Contractor under each section of these Specifications shall arrange for a permit from the local authority. The Contractor shall arrange for all utility services, including electric services. If any charges are made by any of the utility companies due to the work on this project, the Contractor shall pay these charges, including charges for metering, connection, street cutting, etc. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these Specifications.

1.13 TESTING:

- A. General: The Contractor under each division shall at his own expense perform the various tests as specified and required by the Architect and as required by the State and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests.

1.14 LAWS, CODES AND ORDINANCES:

- A. General: All work shall be executed in strict accordance with all local, state and national codes, ordinances and regulations governing the particular class of work involved, as interpreted by the inspecting authority. The Contractor shall be responsible for the final execution of the work under this heading to suit those requirements. Where these Specifications and the accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect, shall prepare any supplemental drawings required illustrating how the work may be installed so as to comply and, on approval, make the changes at no cost to the Owner. On completion of the various portions of the work the installation shall be tested by the constituted authorities, approved and, on completion of the work, the Contractor shall obtain and deliver to the Owner a final certificate of acceptance.

1.15 COOPERATION:

- A. General: The contractor for the work under each section of these Specifications shall coordinate his work with the work described in all other sections of the Specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these Specifications shall be handicapped, hindered or delayed at any time.

1.16 COORDINATION OF TRADES:

- A. General: The Contractor shall be responsible for resolving all coordination required between trades. For example, items furnished under Divisions 21, 22 and 23 which require electrical connections shall be coordinated with Division 26 for:
  - 1. Voltage
  - 2. Phase
  - 3. Ampacity
  - 4. No. and size of wires
  - 5. Wiring diagrams
  - 6. Starter size, details and location
  - 7. Control devices and details
- B. Ceiling Mounted Items: Items installed in/on finished ceilings shall be coordinated with the ceiling construction. The Contractor under each section shall conform to the reflected ceiling plan and shall secure details and/or samples of the ceiling materials as necessary to insure compatibility. Any device not conforming to this requirement shall be replaced by the Contractor at his expense.
- C. Electrical Items: All items specified under Divisions 26 shall be installed tight, plumb, level, square and symmetrically placed in relation to the work of other trades.

1.17 CUTTING AND PATCHING:

- A. General: The Contractor for work specified under each section shall perform all structural and general construction modifications and cut all openings through either roof, walls, floors or ceilings required to install all work specified under that section or to repair any defects that appear up to the expiration of the guarantee. All of this cutting shall be done under the supervision of the Architect and the Contractor shall exercise due diligence to avoid cutting openings larger than required or in wrong locations.
- B. Structural Members: No cutting shall be done to any of the structural members that would tend to lessen their strength, unless specific permission is granted by the Architect to do such cutting.
- C. Patching: The Contractor for work under each section shall be responsible for the patching of all openings cut to install the work covered by that section and to repair the damage resulting from the failure of any part of the work installed hereunder.

- D. Coordination: Before bidding, the Contractor shall review and coordinate the cutting and patching required with all trades.
- E. Existing Surfaces: In all spaces where new work under Division 26 is installed and no other alteration or refinishing work is shown or called for, existing floors, walls and ceilings shall be restored to match existing conditions. Workmen skilled in the affected trade shall do all cutting and patching.
- F. Masonry Walls: Where openings are cut through masonry walls, the Contractor under each respective section shall provide and install lintels or other structural supports to protect the remaining masonry and adequate support shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc. shall be of the size, shape, and installed as directed by the Architect.

1.18 PAINTING:

- A. General: Painting for Division 26 shall be as follows:
- B. If the factory finish on any apparatus or equipment is marred, it shall be touched up and then given one coat of half-flat-half-enamel, followed by a coat of machinery enamel of a color to match the original. Paint factory primed surfaces.
- C. Paint all exposed conduit, boxes, cabinets, hangers and supports, and miscellaneous metal.
- D. Generally, painting is required on all surfaces such that no exposed bare metal is visible.

1.19 LARGE APPARATUS:

- A. General: Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through windows, doorways or shafts, shall be brought to the job by the Contractor involved and placed in the space before the enclosing structure is completed.

1.20 RELOCATION OF EXISTING INSTALLATIONS:

- A. General: There are portions of the existing electrical system that shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of his particular trade and that of all other trades. All such existing installations that interfere with new installations shall be relocated by the Contractor under the Division in which the existing material normally belongs, and in a manner as directed by the Architect. For example where existing conduit and electrical equipment interferes with the installation of new work; it shall be relocated under Division 26. Failure to become familiar with the extent of the relocation work involved shall not relieve the Contractor of responsibility and shall not be used as a basis for additional compensation.

1.21 ROUGH-IN AND MAKE FINAL CONNECTION FOR EQUIPMENT:

- A. General: The shop drawings for all equipment are hereby made a part of these Specifications. The Contractor under each section of the Specifications shall rough-in for the exact item to be furnished on the job, whether in another section of the Specifications or by the Owner. The Contractor shall refer to all drawings and other sections of the Specifications for the scope of work involved for the new equipment, and by actual site examination determine the scope of the required equipment connections for the Owner furnished equipment.
- B. Discrepancies: Should any of the equipment furnished require connections of a nature different from that shown on the drawings, report the matter to the Architect and finally connect as directed by the Architect. Minor differences in the equipment furnished and that indicated on the drawings will not constitute ground for additional payment to the Contractor.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.



## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alcan Products Corporation; Alcan Cable Division.
  2. American Insulated Wire Corp.; a Leviton Company.
  3. General Cable Corporation.
  4. Senator Wire & Cable Company.
  5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN

### 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Hubbell Power Systems, Inc.
  3. O-Z/Gedney; EGS Electrical Group LLC.
  4. 3M; Electrical Products Division.
  5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway  
Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway
- C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway
- D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Branch Circuits: Not more than one power or lighting circuit shall be installed in a single conduit. All branch circuits requiring neutral connections shall be installed with dedicated neutrals in a single conduit.

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.7 FIELD QUALITY CONTROL

- A. Testing: Contractor shall Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

## SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.

### 3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

### 3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

### 3.4 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer.
  1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### 3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- B. Grounding system will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 05 26

## SECTION 26 052 9 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### 1.4 PERFORMANCE REQUIREMENTS

- A.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.



- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
      - 6)
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  6. Toggle Bolts: All-steel springhead type.
  7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 .
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

## SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Metal wireways and auxiliary gutters.
  - 3. Surface raceways.
  - 4. Boxes, enclosures, and cabinets.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.
- I. ARC: Aluminum rigid conduit.
- J. GRC: Galvanized rigid steel conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
  - 7. Republic Conduit.
  - 8. Robroy Industries.
  - 9. Southwire Company.
  - 10. Thomas & Betts Corporation.
  - 11. Western Tube and Conduit Corporation.
  - 12. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.

- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew or compression with insulated throats so not to damage the insulation during wire pulling operations.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.
  
- C. Tele-Power Poles:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.
  - 2. Material: Aluminum with clear anodized finish.
  - 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a Pentair company.
  - 7. Hubbell Incorporated; Killark Division.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney; a brand of EGS Electrical Group.
  - 12. RACO; a Hubbell Company.
  - 13. Robroy Industries.
  - 14. Spring City Electrical Manufacturing Company.
  - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  - 16. Thomas & Betts Corporation.
  - 17. Wiremold / Legrand.

- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, [aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb . Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Fiberglass.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
  - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
  2. Concealed Conduit, Aboveground: EMT.
  3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
  3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install surface raceways only where submitted and approved by the Architect, Owner or Engineer.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .
- G. Metal-clad type MC cable shall not be used in any location.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. A. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Y. Locate boxes so that cover or plate will not span different building finishes.
- Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- BB. Set metal floor boxes level and flush with finished floor surface.
- CC. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

## SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

#### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop

Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

### 2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

### 2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

### 2.4 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## 2.5 UNDERGROUND-LINE WARNING TAPE

### A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

## 2.6 WARNING LABELS AND SIGNS

### A. Comply with NFPA 70 and 29 CFR 1910.145.

### B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

### C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

## 2.7 INSTRUCTION SIGNS

### A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 EQUIPMENT IDENTIFICATION LABELS

### A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

## 2.9 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch .
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi .
  - 3. Temperature Range: Minus 40 to plus 185 deg F .
  - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch .
  - 2. Tensile Strength at 73 deg F , According to ASTM D 638: 12,000 psi .
  - 3. Temperature Range: Minus 40 to plus 185 deg F .
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch .
  - 2. Tensile Strength at 73 deg F , According to ASTM D 638: 7000 psi .
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F .
  - 5. Color: Black.

## 2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.



- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
  - 3. UPS.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

- b. Colors for 208/120-V Circuits:
  - 1) Phase A: Black.
  - 2) Phase B: Red.
  - 3) Phase C: Blue.
  
- c. Colors for 480/277-V Circuits:
  - 1) Phase A: Brown.
  - 2) Phase B: Orange.
  - 3) Phase C: Yellow.
  
- C. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color coding conductor tape.
  
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
  
- E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
  
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
  
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
  
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
  
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
  - a. Power transfer switches.
  - b. Controls with external control power connections.
  
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
  
- K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
  
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - e. Enclosed switches.
    - f. Enclosed circuit breakers.
    - g. Contactors.

END OF SECTION 26 05 53

## SECTION 26 09 23 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Indoor occupancy sensors.
- B. Related Requirements:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Leviton Mfg. Company Inc.
  4. Lightolier Controls.
  5. Lithonia Lighting; Acuity Lighting Group, Inc.
  6. Lutron Electronics Co., Inc.
  7. NSi Industries LLC; TORK Products.
  8. RAB Lighting.
  9. Sensor Switch, Inc.
  10. Square D; a brand of Schneider Electric.
  11. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  5. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  7. Bypass Switch: Override the "on" function in case of sensor failure.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
  - 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Industries, Inc.
  - 2. Hubbell Building Automation, Inc.
  - 3. Leviton Mfg. Company Inc.
  - 4. Lightolier Controls.
  - 5. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 6. Lutron Electronics Co., Inc.
  - 7. NSi Industries LLC; TORK Products.
  - 8. RAB Lighting.
  - 9. Sensor Switch, Inc.
  - 10. Square D; a brand of Schneider Electric.
  - 11. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor:
  - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
  - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
  - 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
  - 4. Voltage: Match the circuit voltage; dual-technology type.
  - 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  - 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

## 2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Division 26 Section "Network Lighting Controls."
- B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23



## SECTION 26 24 16 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Lighting and appliance branch-circuit panelboards.

#### 1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 6. Include wiring diagrams for power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

#### 1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

#### 1.10 PROJECT CONDITIONS

##### A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Altitude: Not exceeding 6600 feet.

##### B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

#### 1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush and surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor. Provide as indicated on the drawings.
  - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections. Provide as indicated on the drawings.
  - 5. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
  - 6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D-ILINE or comparable product by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Mains: Provide as indicated on the drawings.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D-NQ/NF or comparable product by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Provide as indicated on the drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D overcurrent devices or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Provide ratings as indicated on the drawings.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: [Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

## 2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.
- I. All spare circuit breakers shall be left in the off position.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16



## SECTION 26 27 26 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Weather-resistant receptacles.
  - 3. Snap switches and wall-box dimmers.
  - 4. Communications outlets.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

#### 2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

## 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5361C (single), 5362C (duplex).
    - b. Hubbell; HBL5361 (single), HBL5362 (duplex).
    - c. Leviton; 5361A (single), 5362A (duplex).
    - d. Pass & Seymour; 5361A (single), 5362A (duplex).

## 2.4 GFCI RECEPTACLES

- A. General Description:
1. Straight blade, non-feed-through type.
  2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; VGF20.
    - b. Hubbell; GFR5362SG.
    - c. Pass & Seymour; 2095.
    - d. Leviton; 7590.

## 2.5 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; CWL520R.
    - b. Hubbell; HBL2310.
    - c. Leviton; 2310.
    - d. Pass & Seymour; L520-R.

## 2.6 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Single Pole:

- 1) Cooper; AH1221.
- 2) Hubbell; HBL1221.
- 3) Leviton; 1221-2.
- 4) Pass & Seymour; PS20AC1.

b. Two Pole:

- 1) Cooper; AH1222.
- 2) Hubbell; HBL1222.
- 3) Leviton; 1222-2.
- 4) Pass & Seymour; PS20AC2.

c. Three Way:

- 1) Cooper; AH1223.
- 2) Hubbell; HBL1223.
- 3) Leviton; 1223-2.
- 4) Pass & Seymour; PS20AC3.

d. Four Way:

- 1) Cooper; AH1224.
- 2) Hubbell; HBL1224.
- 3) Leviton; 1224-2.
- 4) Pass & Seymour; PS20AC4.

C. Pilot-Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; AH1221PL for 120 and 277 V.
- b. Hubbell; HBL1201PL for 120 and 277 V.
- c. Leviton; 1221-LH1.
- d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; AH1221L.
- b. Hubbell; HBL1221L.
- c. Leviton; 1221-2L.
- d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

## 2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces (Stainless Steel): 0.035-inch- thick, satin-finished stainless steel.
  3. Material for Unfinished Spaces (Stainless Steel): 0.035-inch- thick, satin-finished stainless steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.8 SERVICE POLES

- A. Description:
  1. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
  2. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
  3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
  4. Finishes: Satin-anodized aluminum.
  5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.
  6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
  7. Voice and Data Communication Outlets: complying with requirements in Division 27 Section "Communications Horizontal Cabling."

## 2.9 FINISHES

- A. Device Color:
  1. Wiring Devices Connected to Normal Power System: Almond unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red.
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles (Inside Only): At each device identify the panel and circuit number to which the device is finally connected in indelible ink on the inside of the device coverplate and on the inside of the outlet box.
2. Switches: Where more than two switches are located within 8" of each other on a wall, provide permanent labels indicating switch function.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.

3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  3. Using the test plug, verify that the device and its outlet box are securely mounted.
  4. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).
- D. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 27 26



## SECTION 26 51 19 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior solid-state luminaires that use LED technology.
- 2. Lighting fixture supports.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.
  5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  6. Photometric data and adjustment factors based on laboratory tests, IES LM-79 and IES LM-80.
    - a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
  2. Suspended ceiling components.
  3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
  4. Structural members to which equipment and/or luminaires will be attached.
  5. Initial access modules for acoustical tile, including size and locations.
  6. Items penetrating finished ceiling, including the following:
    - a. Other luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Ceiling-mounted projectors.
  7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Product Certificates: For each type of luminaire.
- E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- F. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
  - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

#### 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- G. CRI of minimum 80. CCT of 3000 K.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: As scheduled.
- L. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

## 2.2 MATERIALS

### A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

### B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

### C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

### D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
  - a. "USE ONLY" and include specific lamp type.
  - b. Lamp diameter, shape, size, wattage, and coating.
  - c. CCT and CRI for all luminaires.

## 2.3 METAL FINISHES

### A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

### A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

### B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

### C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

### D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

### E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
3. Ceiling mount with hook mount.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

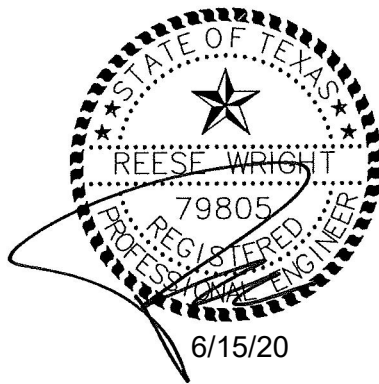


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## SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. UTP cabling.
- 2. Multiuser telecommunications outlet assemblies.
- 3. Cable connecting hardware, patch panels, and cross-connects.
- 4. Telecommunications outlet/connectors.
- 5. Cabling system identification products.
- 6. Cable management system.

- B. Related Requirements:

- 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. Cabling administration drawings and printouts.
  - 3. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Patch-Panel Units: One of each type.
  - 2. Connecting Blocks: One of each type.
  - 3. Device Plates: One of each type.
  - 4. Multiuser Telecommunications Outlet Assemblies: One of each type.

### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Installer shall be a Panduit certified installer.
  - 4. Completed project shall be eligible to receive the Panduit 25 year warranty.

### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
  - 2. Test each pair of UTP cable for open and short circuits.

## PART 2 - PRODUCTS

### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
  - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with J-STD-607-A.

### 2.3 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

## 2.4 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements of Panduit for qualifications for the 25 year warranty.
- B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
  - 3. Comply with TIA/EIA-568-B.2, Category 6.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG.
    - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    - d. Communications, Limited Purpose: Type CMX.
    - e. Multipurpose: Type MP or MPG.
    - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

## 2.5 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Panduit Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Both ends of cable shall be terminated with jacks. The MDF/IDF end of the cables shall be terminated in a modular jack field.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
  - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

- G. Patch Cords: Factory-made, four-pair cables in 84-inch lengths; terminated with eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.

## 2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
  - 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
  - 3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.7 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

## 2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 2.9 CABLE MANAGEMENT SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Panduit.
- B. Description: Computer-based cable management system, with integrated database capabilities.

- C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- D. Information shall be presented in database view, schematic plans, or technical drawings.
  - 1. AutoCAD drawing software shall be used as drawing and schematic plans software. Electronic copies of the files shall be provided to UTPB Information Resources Division.

## 2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."



3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install modular jack termination hardware.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches] apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

F. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  1. Administration Class: 3.
  2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

- 1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- B. Perform the following tests and inspections:

- 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
  - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- 5. UTP Performance Tests:

- a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

- 1) Wire map.
      - 2) Length (physical vs. electrical, and length requirements).
      - 3) Insertion loss.
      - 4) Near-end crosstalk (NEXT) loss.
      - 5) Power sum near-end crosstalk (PSNEXT) loss.
      - 6) Equal-level far-end crosstalk (ELFEXT).
      - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
      - 8) Return loss.
      - 9) Propagation delay.
      - 10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

END OF SECTION 27 15 00

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SECTION 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Fire alarm wire and cable.
  - 2. Identification products.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- B. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each pair of UTP cable for open and short circuits.



## 1.7 FIELD CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
  - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Comtran Corporation.
  - 2. Draka Cableteq USA.
  - 3. Genesis Cable Products; Honeywell International, Inc.
  - 4. Rockbestos-Suprenant Cable Corp.
  - 5. West Penn Wire.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

## 2.3 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Worldwide, Inc.
2. HellermannTyton North America.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

### 3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be 3/4 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
2. Comply with requirements in Section 280528 "Pathways for Electronic Safety and Security."
3. Comply with requirements in Section 260536 "Cable Trays for Electrical Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

- B. Wiring Method: Install wiring in metal raceway according to Section 260533 "Raceways and Boxes for Electrical Systems."
1. Install plenum cable in environmental air spaces, including plenum ceilings.
  2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
  2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
  3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

- A. Comply with requirements in Section 281300 "Access Control" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Section 282300 "Video Surveillance" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

- A. For communications wiring, comply with J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

Perform the following tests and inspections:

1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

END OF SECTION 28 05 13

## SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  1. Manual fire-alarm boxes.
  2. System smoke detectors.
  3. Heat detectors.
  4. Notification appliances.
  5. Addressable interface device.

#### 1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

#### 1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  2. Include voltage drop calculations for notification appliance circuits.
  3. Include battery-size calculations.
  4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.
  - b. NICET-certified fire-alarm technician, Level III minimum.
  - c. Licensed or certified by authorities having jurisdiction.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  3. Record copy of site-specific software.
  4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals.
  5. Manufacturer's required maintenance related to system warranty requirements.



6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Smoke Detectors, Fire Detectors,: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
2. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
3. Keys and Tools: One extra set for access to locked and tamperproofed components.
4. Audible and Visual Notification Appliances: One of each type installed.
5. Fuses: Two of each type installed in the system.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

#### 1.10 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

#### 1.11 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

#### 1.12 CONTRACTORS

- A. All items for the digital addressable fire alarm system specified herein to be provided by Systech, Odessa, Texas. Contact: Larry Thorton; 432-550-7964.
- B. Substitutions: Not permitted.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by EST, Inc. to match the existing system devices.

## 2.2 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  2. Station Reset: Key- or wrench-operated switch.
  3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
  4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
  5. Provide EST Signa series devices.

## 2.3 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Detectors shall be four-wire type.
  3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
  6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
- B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Provide EST Signa series detectors.

## 2.4 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  3. Provide EST Signa series detectors.

## 2.5 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
  1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
  1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
  2. Mounting: Wall mounted unless otherwise indicated.
  3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.
7. Provide EST Genesis series devices.

E. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Mounting: Flush.
4. Matching Transformers: Tap range matched to acoustical environment of speaker location.
5. Provide EST Genesis series devices.

## 2.6 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  1. Connect new equipment to existing control panel in existing part of the building.
  2. Connect new equipment to existing monitoring equipment at the supervising station.
  3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

- F. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling or as indicated on the drawings. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling or as indicated on the drawings.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

### 3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
  - 4. Alarm-initiating connection to elevator recall system and components.
  - 5. Alarm-initiating connection to activate emergency lighting control.
  - 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  - 7. Supervisory connections at valve supervisory switches.
  - 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 9. Supervisory connections at elevator shunt trip breaker.
  - 10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11